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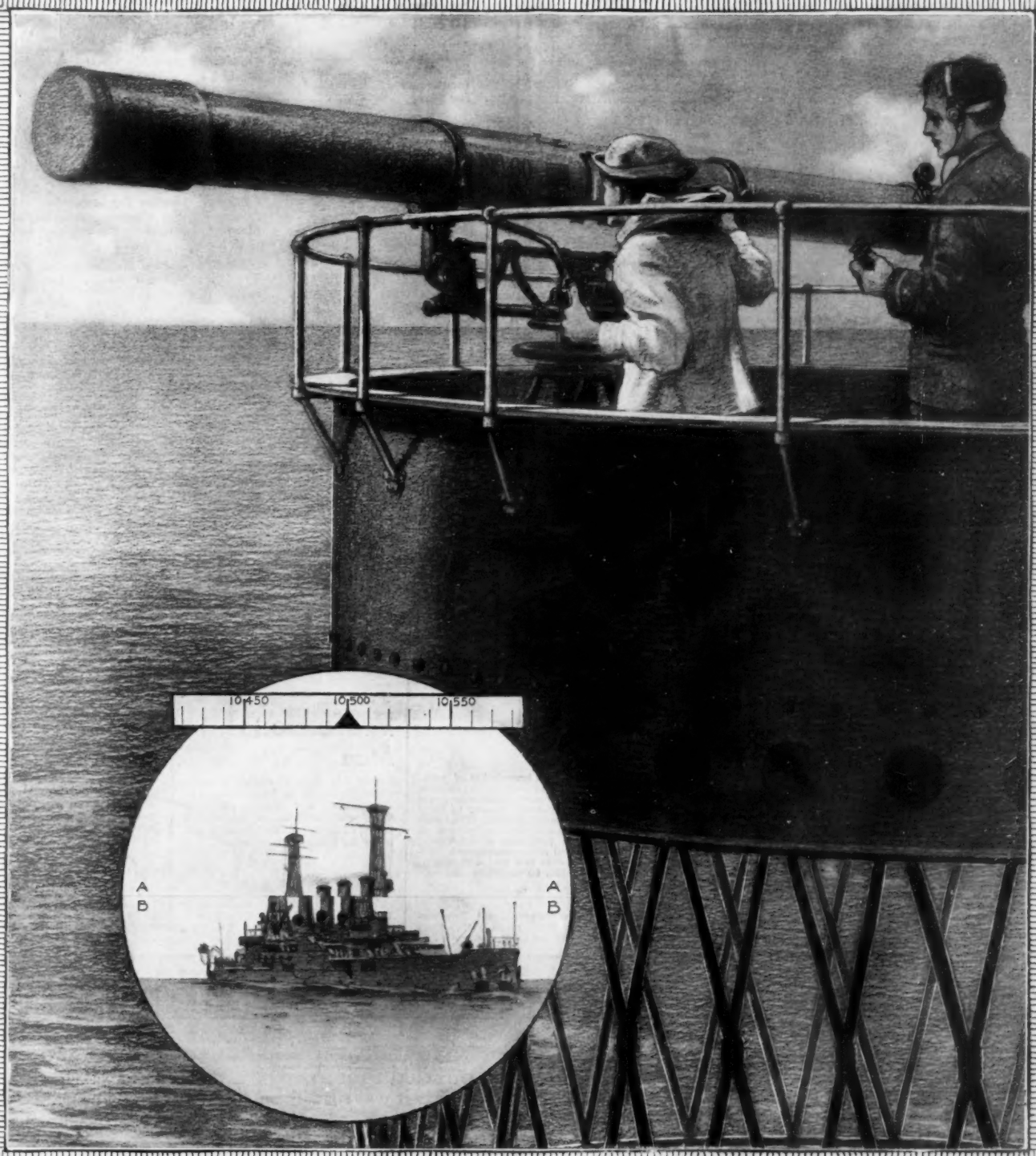

Fire Control Platform of a U. S. Battleship
The Great Los Angeles Aqueduct

Vol. CIX. No. 19
November 8, 1913

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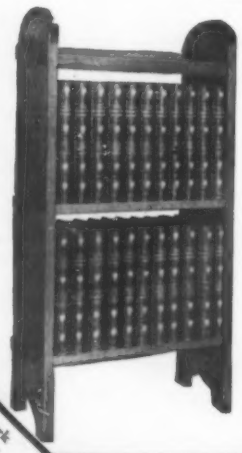

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NEW YORK, NOVEMBER 8, 1913

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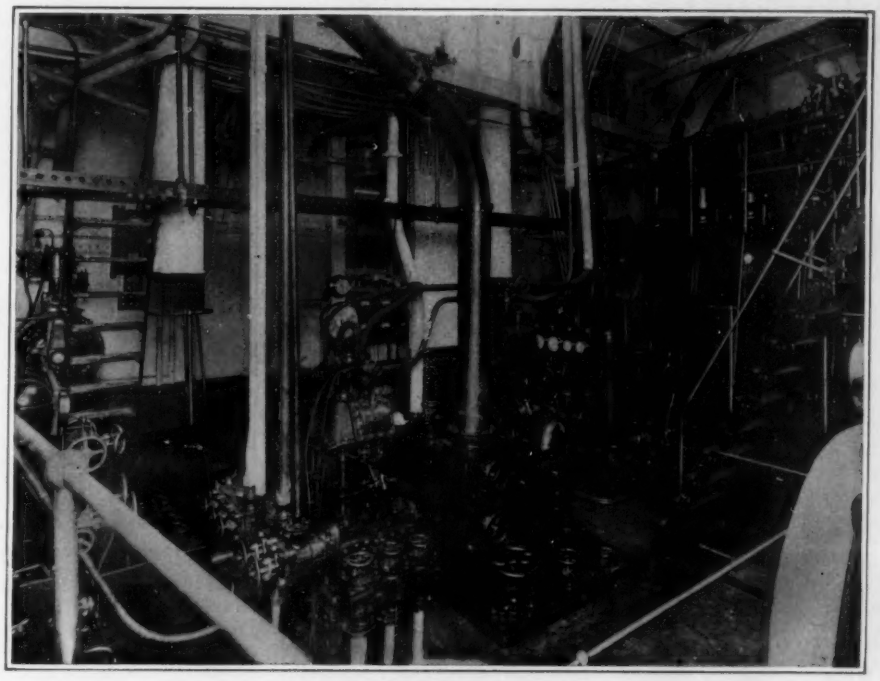
The Electrically-driven Vessel "Tynemount"

By Frederick C. Coleman

THE first ocean-going vessel directly driven by electricity has just been completed at Wallsend-on-Tyne, England, and is about ready to cross the Atlantic Ocean for service on the Great Lakes. The operation on this vessel will be watched with great interest, for although the same type of propulsion was used on the small "Electric Arc," the latter is not to be compared with the "Tynemount," which has a length of 250 feet, beam 42 feet 6 inches, molded depth 19 feet, and a cargo capacity of 2,400 tons.

The propelling machinery of the "Tynemount" is accommodated in a compact engine-room under the poop of the vessel, and occupies only about one sixth of the ship's length. On opposite sides of this room are two six-cylinder Diesel engines, each capable of developing 300 brake horse-power at 400 revolutions per minute. Direct connected to each engine is a 3-phase generator furnishing electric power to an induction motor mounted directly on the propeller shaft. The alternators when running at their normal speed of 400 revolutions per minute each give an output of 500 volts and 270 amperes per phase, which absorbs the full power of the engine. An exciter is direct coupled to each alternator and is capable of giving an exciting current of 30 amperes for normal working, which can be increased up to 50 amperes while maneuvering.



View of the engine-room, showing one of the generating sets.

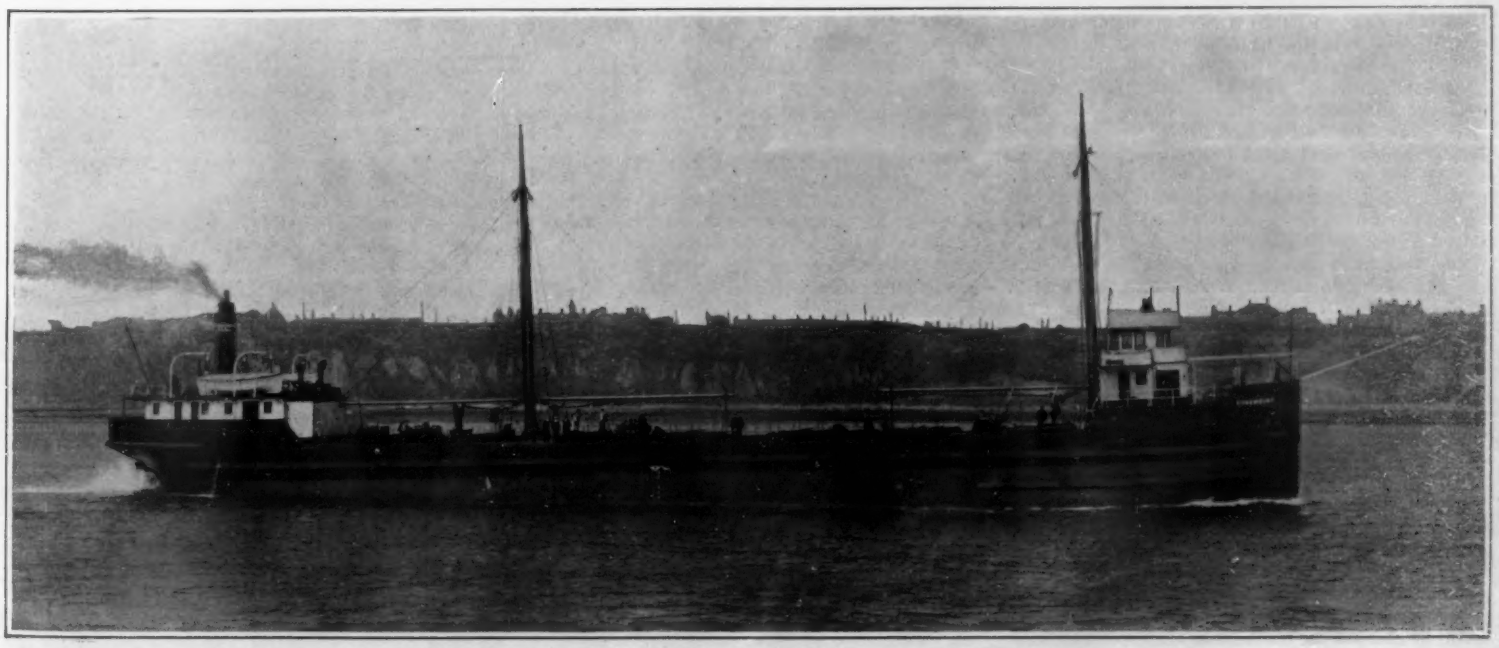
In ordinary practice where two alternating-current generators are connected in parallel it is necessary that they be run up to speed, and be synchronized before being switched on to the load. But such an operation would be impracticable in ship work. Accordingly, a very ingenious arrangement has been adopted. The two generators are provided with six and eight poles, respectively, giving a frequency of 20 and 26.6 cycles per second, respectively. The rotor of the motor is of the well-known squirrel cage type, but the stator is provided with two entirely separate windings, one of thirty and the other of forty poles. When these two windings are supplied with current at 20 and 26.6 cycles, respectively, they give the same synchronous speed of 80 revolutions per minute. The motor then absorbs the full power of both engines, and drives the propeller to which it is directly coupled at a speed of 78 revolutions per minute. To obtain a lower speed, the connections are altered so that the 20-cycle generator supplies the 40-pole winding of the motor, while the 26.6 cycle alternator is shut down, thus throwing the 30-pole winding of the motor out of service. The synchronous speed of the motor with the propeller is now reduced to sixty revolutions per minute. Only one of the engines is in service. But as the speed of the ship is cut down to about three quarters of the normal, half of the total horse-power is ample. Thus considerable economy of service is obtained; for reduced speed is obtained not by varying the speed of the engines, but by cutting out one of them completely and letting the other continue to operate at its most efficient speed. The two alternators, when both are at work, are connected to entirely separate circuits, and are therefore never run in parallel, so that it is unnecessary to synchronize them. The motors are readily reversed by interchanging the connection of the two phases.

The switch gear consists of a controller having five different positions, full speed ahead, half speed ahead, stop, half astern, and full astern, while a second switch is employed for the purpose of introducing resistance into the shunt circuit of the exciter. The contacts of both switches work under oil, but it is inadvisable that the contacts on the main switch should be required to break the large main current flowing to the motor. The two switches are therefore interlocked, so that it is impossible to work the main switch except when all the resistance has been introduced into the exciter field coil. There is then practically no excitation, and the whole system is dead. With the resistance in the exciter field circuit, the main switch can be moved to any one of its four working positions, and when the main connection has been made for the new running position, the shunt switch lever is pulled over, so as to cut off resistance and restore excitation.

It will be seen that the whole handling of the ship can be carried out by means of two levers which are so interlocked as to be practically fool-proof. In the present instance these switches are in the engine room, but it is evident that by lengthening the connecting cables they could be placed on the navigating bridge.

The number of electrical instruments provided has been kept down to a minimum. There is only one ammeter and one voltmeter for each alternator and an ammeter and voltmeter for each exciter. The handling of the switch gear is so simple that there is no necessity for multiplication of measuring instruments.

The electrical drive allows of a reduction in the machinery space and also in the bunker space required, thus increasing the cargo capacity of the vessel. As a subsidiary advantage, it lends itself readily to distant control, and in any case where it may be found advisable the switchgear can be put on the bridge, thus placing the control of the motor driving the propeller into the hands of the navigating officer.



The "Tynemount," a freighter for the Great Lakes, driven by electricity generated by two Diesel-engine-alternator sets.

Note the oak fender along the sides for protection in the locks.

SCIENTIFIC AMERICAN

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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Scientific American's Contribution to the Development of the Racing Aeroplane

AT the time of the aeroplane meet which was held on Long Island in the autumn of 1910, the Editor of the SCIENTIFIC AMERICAN undertook to forecast the line of development which would be followed in the designing of future racing aeroplanes. In an article published in our issue of October 22nd, 1910, we wrote: "A study of the trend of development in aeroplane construction renders it possible to predict, with some degree of certainty, the leading characteristics of the aeroplane of the future, and especially of that type which will be built purely for racing purposes." Our design was based upon a recognition of the fundamental principles: that the chief resistances encountered by an aeroplane are those due to the lift and the head surface, or total projected vertical area, and that while the resistance due to the former is fairly constant, the head resistance increases approximately as the square of the speed, and that hence it is necessary in a racing machine to reduce the head resistance to the least possible limit consistent with structural requirements.

We pointed out that this consideration of head resistance ruled out the biplane because of its mass of struts and wires, and rendered it necessary to design the monoplane strictly in accordance with the streamline theory of resistance; that it necessitated the abolition from the monoplane of external struts and guy-wires; the adoption of a body of torpedo form; and the construction of planes of sufficient thickness to admit of building entirely within their external surfaces internal girders or frames having sufficient transverse strength to prevent buckling and hold the wings up to their work. It was suggested, moreover, that the body and wings, as thus modeled, should be built entirely of some high-grade steel alloy, such for instance as vanadium steel—a construction which the rapid development of the tensile and other desirable qualities of alloys promised to render possible in the near future. Furthermore, it was predicted that such a machine, provided with a Gnome motor of from 75 to 150 horse-power, according to the size of the machine, would be capable of making speeds of from 100 to 125 miles an hour.

So much for prediction. The event has proved that, in the technical world at least, prophecy based upon a recognition of fundamental scientific laws cannot go very far wide of the mark. This is shown by a study of the winning machines in the three contests for the Gordon Bennett Cup which have taken place since this article was published.

The Nieuport monoplane, with which Weymann captured the cup for America in the 1911 meet held in England, was built in accordance with the streamline theory, the long, tapered fuselage being entirely covered in with fabric. With a motor of 100 horse-power, this machine easily surpassed its competitors, averaging 78.1 miles per hour, as against 75.9 miles per hour made by a Blériot of equal power.

In the meet of 1912, the winning machine, a Deperdussin monoplane, which covered the course at a speed of 106 miles per hour, showed a still closer approximation to the SCIENTIFIC AMERICAN type. The body, of torpedo form, was sheathed in with a smooth coat of thin, laminated wood; and although the struts and guy wires were still present in the machine, they had been cut down to offer as small a head resistance as then was thought practicable.

In the race for the cup held in France on September 29th, 1913, it is significant that a speed of 125 miles an hour, predicted by us in 1910, was achieved by a machine which bears a remarkable likeness to the one pictured by us at that time. Not only is it of true torpedo form, but the construction of the wings and the running gear shows evidence of a further effort to reduce head resistance and eddy making. The struts for the overhead guy wires are very low; the wheels are sheathed; and the frames in which they are carried are formed with a cross-section calculated to present as small wind resistance as possible.

In one respect our prediction as to the form of the future aeroplane has proved to be wrong. Basing our expectation upon Langley's experiments, we believed that the wings of the future racer, like those of the albatross, would be long and narrow. Experience has proved that better results are obtained with a wing that is relatively short and broad—and this, by the way, is strictly in favor of the construction of wings free from guy wires, in which the proper transverse strength is afforded by girders placed entirely within the wings. The bending stresses in wings of a given shape increase proportionately to the length of the wing; and if the wing area were so distributed that the wing had a greater width at the body than at the tip, it will be possible to secure sufficient girder depth for strength, and still retain the flat curve which has been found to give the best results at speeds of 100 miles an hour and over.

Prevost's winning machine differs from that suggested by the SCIENTIFIC AMERICAN, furthermore, in the fact that we provided a pneumatic cylinder and connections, by means of which the running gear could be folded back against the body of the aeroplane as soon as it took the air. We are still of the opinion that such a construction is practicable. If it were adopted, the total head-on resistance would be very greatly decreased.

It is of interest to note, in passing, that we suggested for the SCIENTIFIC AMERICAN machine of 1910 the use of a pneumatic cylinder, placed transversely to the body, for operating the wing tips, the valve of the cylinder to be controlled by a small gyroscope. This device is now being used on our army aeroplanes, and is being extensively tried out on many European machines.

In the year 1911, an Antoinette machine entered the military contest in France, and this aeroplane was entirely self-contained; that is to say, the struts and guy wires were abolished and the running gear was low and housed practically within the body. Unfortunately this machine was altogether too large for its power, and the great length of the wings necessitated their being nearly two feet thick at their junction with the body. Had the Antoinette machine been built smaller and of metal, and provided with a Gnome engine of greater power, we believe it would have swept the field.

At the close of the recent contest for the Gordon Bennett Cup, it was predicted in some of the French papers that no further contests would be held; but we cannot believe that America will permit the famous trophy to remain unchallenged in the hands of the French people. Prevost's 125 miles an hour can be beaten, and can be beaten by a machine built in this country. If the guy wires, etc., of Prevost's machine were replaced by metal girders within the wings, the body somewhat lengthened, and "fined out," and the running gear made foldable against or entirely within the body, it is our belief that its 160 horse-power Gnome engine would take it around the same course at a speed approaching 150 miles per hour.

Completion of a Great Engineering Work

THE completion of the Los Angeles aqueduct, as described elsewhere in this issue, marks the successful ending of an arduous struggle with nature in its most rugged aspects of mountain and desert, and with powerful and subtle private interests for the possession of a priceless supply of water. The ten aqueducts of ancient Rome were marvels of engineering skill and durability; but their construction stretched over a period of five centuries, against the eight years that have elapsed since the Los Angeles aqueduct was first proposed, and the length and dimensions of the ancient Roman aqueducts bear no comparison with that of modern Los Angeles. The longest of the Roman aqueducts was 62 miles, while the Los Angeles aqueduct is 254 miles in length, from the intake on Owens River to the city limits of Los Angeles. The irrigation aqueducts of the Inca Indians of ancient Peru, one of which was 360 miles long, are among the wonders of the world, especially so when it is considered that they were constructed by a people uninformed as to modern engineering science and its methods, but these probably exhausted centuries of time. The 350 miles of iron pipe line, 30 inches in diameter, which conveys water across the arid plains of western Australia to the gold mining districts of Kalgoorlie and Coolgardie, is one of the triumphs of modern constructive hydraulic engineering; but this construction, although in a hot and waterless country, was comparatively level, while the Los Angeles aqueduct bores through miles of mountains of solid rock, crosses valleys on pillars of concrete in some places, and through huge steel siphons in others, and is of far greater dimensions than the notable Australian structure.

The great Ashokan aqueduct to supply the city of New York, now in course of construction, is the only modern hydraulic enterprise intended mainly for domestic and industrial use, that compares fairly with the Los Angeles aqueduct. The New York aqueduct crosses the Hudson over a thousand feet beneath the river bed, and it will furnish the metropolis with 500,000,000 gallons daily at a cost, including its various reservoirs, of about $165,000,000. The Los Angeles aqueduct has not much more than half the capacity, it is true; but it is about twice as long, passes through an incomparably rougher country, and its cost, when completed, will be less than one fifth that of the great New York enterprise.

Safety at Sea

THE Committee on Aids and Perils to Navigation formed by Secretary of Commerce Redfield to prepare recommendations for the use of the American delegation to the London International Conference on Safety at Sea to be held in November, recommends that all ocean-going steamers, equipped with electricity, shall carry a searchlight so placed as to illumine all points of the horizon as far as practicable, and of sufficient power to distinguish a ship's 24-foot boat at a distance of not less than one nautical mile on a clear dark night; and that all light vessels on important outside stations shall be equipped with submarine bells, and all ocean-going vessels shall be provided with means for detecting submarine-bell signals. The committee recommends, furthermore, that the International Rules of the Road be modified so that carrying of range lights shall be obligatory instead of optional, as at present, and that all vessels shall also carry a fixed stern light. The International Rules should also be amended to provide that every vessel navigated in the vicinity of icebergs or ice floes during darkness should go at moderate speed, having careful regard to circumstances and conditions. The use of rockets showing red should be restricted to distress signals at night.

In the interests of the future development of radio-meteorological services, the committee recommends that the existing meteorological service of each administration adopt as part of its programme the organization of a radio service for the coastal waters pertaining to that administration. It is further recommended that meteorological observations be made, at Greenwich noon, whenever a vessel during the preceding four hours has experienced a barometer reading below 30 inches and falling continuously, or has discovered other symptoms of approaching storm. That class of meteorological information which transcends all others as regards its value to shipping is the storm or hurricane warning, particularly the latter. The committee considers this warning service as promising more beneficial results than the project of distributing warnings to vessels in mid-ocean, and therefore emphasizes the importance of concentrating all means at the command of meteorological services on the development of an efficient warning service for coastal and subtropical waters. The United States Naval Observatory has developed a time service by radio which has proved of great value to shipping, and the committee recommends a consideration of the desirability of requesting all governments to establish a like service.

For many years the important steamship lines traversing the North Atlantic Ocean between New York, Philadelphia, Boston, and the ports of Europe have agreed among themselves that their vessels should hold to certain prescribed lanes. This plan should be broadened by making the steamship lanes obligatory to steamships. Governments should pass legislation requiring the steamships under their respective flags to adhere strictly to steamship lanes prescribed by them.

In recommending that an International Ice Patrol be established, the committee suggests that the annual responsibility and expense of maintaining this patrol be assumed by each of the several maritime nations in turn, the patrol to be conducted in accordance with a general plan to be formulated and agreed to by the several maritime nations concerned at the International Conference. The ice patrol shall begin April 1st of each year and continue until the ice no longer constitutes a menace to navigation in the zone of the transatlantic steamship lanes. At all times during the continuance of the patrol there must be at least one vessel present in the iceberg region. The committee also recommends that an endeavor be made to reach an agreement with the several maritime nations interested in the transatlantic trade, as follows: The United States to continue the destruction or removal of derelicts in the North Atlantic west of a line drawn from Cape Sable to latitude 34 degrees longitude 70 degrees, and thence to the Bahamas, and other maritime nations to maintain a suitable vessel or vessels for the purpose of destroying or removing derelicts east of said line.

Electricity

Telegraphy from an Aeroplane.—Long distance wireless telegraph experiments recently made from a Bréguet aeroplane to a ground station at Douai, France, showed excellent results. The aeroplane is a three-seated flyer designed for the government of Siam. With Moineau piloting and Engineer Roques operating the wireless apparatus on board, the aeroplane kept on its flight from the aerodrome and sent messages every five minutes to a land station in the town of Douai. The musical wave method was employed, and it is claimed that messages could be heard with the aeroplane as far as 60 miles off, in spite of the small power used in the apparatus on board.

Three-phase Italian Railroad.—In Italy there has lately been put in operation a line of electric road which, although a short one, is of interest on account of the direct use of three-phase current at 42 cycles. The line is laid from the quarries of Basco to the railroad station of Bagni in the neighborhood of Rome, and its length is some 7,000 feet. The three-phase current comes from the Laziale electric station and is delivered by a line working at 11,500 volts, this being reduced by transformers on the spot to 500 volts for operating the electric railroad. Small electric locomotives have 30 horse-power motors of special three-phase design on the Brown-Boveri system, which draw 35-ton rock trains.

Mont Blanc Tourist Lines.—The first of the tourist lines in the region of Mont Blanc was the electric road from Fayet to Chamonix, which was opened in 1901 and extended some years later to the Swiss frontier, where it joins the Martigny-Chatelard electric road, thus connecting the Arve valley with the Federal railroad. The popularity of these electric roads is shown by the fact that six times as many passengers are carried now as in the first period. This great movement led to several projects for mountain lines, and one of these is now completed, this being the steam rack-rail from Chamonix up to the Mer de Glace, opened in 1909. Another new line partly in service, is the rack-railroad from Fayet up Mont Blanc to the peak of Aiguille du Gouter. It is to be extended further up the mountain to a point near the summit. At present the road is constructed only as far as Mt. Lachat. There is also in construction an aerial cableway up the mountain from Pelerins village to Col de Midi and Ballée Vlanche. A recent project calls for an electric road from Chamonix to Mont du Couvercle.

The Julienhütte Rolling Mills in Germany afford a good example of an iron works which employs electric motors almost exclusively, using current from industrial mains. The reversible rolls are operated in this case by an electric motor designed specially for the severe shocks of this class of work on the Allgemeine-Ilgnes system. Such motors are not supplied directly by the line current, but in order to take up the shocks an intermediate machine is used in the shape of an Ilgnes converter. This group receives three-phase current from the electric mains at 6,000 volts and 50 cycles. It has two separate halves, each being made up of a three-phase motor for driving a dynamo in order to furnish current for the rolling mill motor, using a 28-ton flywheel. The two sets, motor and dynamo, can be used separately or combined for the current supply. In standard practice the two dynamos are coupled in series and furnish current to the two 1,800 horse-power motors of the rolling mill, these two motors having their circuits also connected in series. The present mills furnish 50 to 80 tons of rolled metal per hour. We may also mention that three large motors of 2,000 horse-power size are in use in the tube rolling mills of Bismarckhütte.

Corpuscles Emitted by Alkaline Metals.—Prof. J. J. Thompson brought out the fact that corpuscles are emitted by alkaline metals under the action of light, and the effect feebly subsists in the dark. The question has been the object of research on the part of various scientists, which Henriot resumes as follows: The action is seen in the two metals potassium and rubidium, and the effect is analogous to radio-activity. Potassium gives off β-rays which are homogeneous and easily deflected by the magnetic field. Their penetration is about like the β-rays of uranium. As regards rubidium, it also gives off β-rays which are slower and rather homogeneous, and as to absorption they resemble the β-rays of radium. It appears that potassium and rubidium *in vacuo* emit charges spontaneously which are in part due to ionizing β-rays. The existence of slow charges could not be seen. L. Dunoger and E. Miller consider this effect to be due to obscure heat rays and not to radio-activity, and is a photo-electric action set up by the infra-red rays. Woodrow measured the potential and considers the action not a Volta effect but a spontaneous emission of corpuscles like what radio-action produces. However, as H. Thirring claims it to be due to the Volta effect and that such cells act like galvanic cells, it will be seen that the question is far from being settled.

Science

Botanic Garden in South Africa.—The Parliament of the Union of South Africa voted at its last session to establish a large botanic garden at Kirstenbosch, a farm on the Rhodes estates, to the south of Groote Schur, on the eastern slopes of Table Mountain. Prof. H. H. W. Pearson has been appointed director.

Zinner's Comet.—A cablegram received at Harvard from Kiel gives the following position of Zinner's Comet as observed by Graff at Bergedorf:

October 24.2687 G.M.T.
R.A. 18 hours 45 minutes 53.7 seconds.
Declination—5 degrees 23 minutes 23 seconds.

The comet was visible in a small telescope.

Free Radium.—Dr. Charles L. Parsons, chief of the Bureau of the Division of Mineral Technology of the United States Bureau of Mines, announces that through the generosity of Dr. James Douglas of New York city, and Dr. Howard A. Kelly of Johns Hopkins University, twenty-seven claims of mining land in Paradox Valley, Colorado, have been purchased, said to be the greatest radium bearing ore deposit at present known. The National Radium Institute has been incorporated to work the deposits. The entire undertaking is under the supervision of the Bureau of Mines, and all the radium will be at the disposal of physicians free of charge.

Harvest Weather Forecasts.—This name is applied in Great Britain to telegraphic weather forecasts for farmers, issued by the Meteorological Office in London every day from June 1st to September 30th, at 2:30 P.M., on the basis of observations taken at the meteorological stations at 1 P. M. They cover a period of 15 hours; viz., from 6 A. M. to 9 P. M. of the following day. When conditions are sufficiently definite a "further outlook" extending the period covered by the forecast to two or more days is added. The office issues a special notice to farmers whenever a spell of several consecutive days of fair weather appears probable. The service is free, except that recipients pay the cost of the telegrams. The Board of Agriculture and Fisheries has just issued a notice calling the attention of farmers to the harvest forecasts and explaining how they may be obtained.

Roselle.—The news that a canning factory in the Philippines has begun to manufacture roselle sauce is of interest as marking the initial commercial stage of an industry possessing great possibilities. Roselle (*Hibiscus sabdariffa* Linn.) was introduced a few years ago into the far southern United States from the West Indies, and has just begun to be cultivated in the Philippines. Until recently the only edible part of the plant was supposed to be the fleshy calyces, from which can be made a sauce exactly resembling cranberry sauce in appearance and flavor, as well as sirup, jelly, and wine. Lately it has been found that the leaves and young stems of the plant also yield palatable products, and the exploitation of roselle has been furthered by publications of the United States Department of Agriculture and the Philippine Bureau of Agriculture.

The Schröder-Stranz Expedition.—The tragic collapse of this expedition in Spitzbergen has already been reported in these columns. Capt. Staxrud, who rescued the survivors from their ship at Treurenburg Bay, carried them overland to Advent Bay, from which point part proceeded to Norway and part to Germany. A legal investigation has been undertaken at Christiania concerning the reported dissensions between the Norwegian crew of the expedition's ship and the German scientific staff, which may have had something to do with the deplorable outcome of the enterprise. Early in June Capt. Staxrud set out again from Advent Bay with the intention of proceeding *via* Treurenburg Bay across Hinlopen Strait and exploring the northern coast of North East Land for traces of Schröder-Stranz himself and his lost companions. There is, however, hardly any hope that they have survived.

Franz Josef Land is one of the three regions that are focusing the attention of the world in connection with the present active campaign of Arctic exploration, the others being Spitzbergen and the problematical Crocker-land. At the end of August, 1912, a Russian expedition under Capt. Sedow sailed for Franz Josef Land, with the hope of ultimately pushing on to the pole. The enterprise appears to have been poorly equipped and badly organized, and the start was made dangerously late in the season, especially as the winter set in earlier than usual last year in the Arctic seas north of Europe. After being damaged in a storm, the ship made a stop in Nova Zembla, and again proceeded north September 12th. Early in November rumors reached Europe that the party had been shipwrecked. Its actual fate is still uncertain, and the question of sending out a relief expedition is now being agitated in Russia. An alternative suggestion is that the Russian government shall aid in pushing forward the expedition to Franz Josef Land which M. Jules de Payer has been organizing for some time in France, and which was planning to sail before the end of the present summer in the Norwegian steamer "Loydsen."

Aeronautics

An Omnibus Aeroplane.—Guiseppe Colucci of Boston, Mass., has patented a flying machine which has a plurality of pairs of supporting wings extended from its body and being alternately monoplanes and biplanes together with which he uses a pivotally mounted substantially horizontal elevating plane. The patent is No. 1,068,108.

The Bantzen Aviation Station.—The aviation station of Bantzen is soon to be completed, and it will take a good rank from the fact that it lies between Berlin and Vienna, it being proposed to establish an aerial connection between these two capitals before long. Upon the inauguration of the new establishment there will be a number of events such as altitude tests and bomb throwing, destruction of railroads and other works.

An Aeroplane Propeller with Valve Openings.—Herbert Prince of New York city, in patent No. 1,068,271, shows a propeller for aeroplanes which has a number of blades rotating about a common axis and air passages with pivoted vanes for controlling the passages. Rack gearing is provided for opening and closing the vanes, and a cam mechanism operates upon the gearing to open the vanes of one blade while it closes the vanes of another blade. Means are also provided for varying the action of the cam gearing.

Moreau's Sacrifices.—Moreau, the French inventor who recently won the Bonnet prize for flying with his hands off the controls of his machine, has an interesting history. He is employed by a large printing house in Paris. Most of the money that he earns is devoted to aviation. His family and himself must content themselves with the bare means of subsistence. Despite his modest income he has done wonders in designing his automatically stable machine. It is to be hoped that the winning of the Bonnet prize funds by Moreau will induce either the French government or wealthy French patrons of aviation to take an interest in him.

A New Schütte-Lanz Airship.—The second Schütte-Lanz airship of the German army, known as "S.L. II," and designed by Prof. Lanz, is now nearing completion at Mannheim. The new airship contains 847,000 cubic feet of gas. It has five cars, one for the commander in front and four for the crew. Two of these four cars are loosely suspended in the center line fore and aft, and the two others are fixed rigidly in the middle on each side of the center line. Four motors, three Maybach and one Daimler, drive the airship. Two propellers are connected with each motor. The speed of the vessel is estimated at 45 miles an hour.

The Eiffel Tower Weather Reports.—Military aeronauts are now receiving weather reports from the Eiffel Tower wireless post, and this special service was started running a short time ago. Each day there are sent out two weather bulletins, at 10 A. M. and 5 P. M., and these are received by all the military wireless stations, being specially drawn up for the needs of army aeronauts. The chief officers at each station will be thus able to draw up weather charts and to interpret these according to local conditions. It was upon favorable notice from the Tower that Dubonnet and Rumpelmayer made recent balloon trips, and the airship "Adjutant Vincenot" started on a long voyage from Paris. Guillaux made his aeroplane trip to Hamburg and Letort left for Berlin upon the same advice.

The British Airship "Eta."—The "Eta," the last of the series of small experimental airships built at the royal aircraft factory, is now undergoing tests. The ship is a modified Parseval in type. The capacity is 100,000 cubic feet. There are two radial stationary 160 horse-power engines set on opposite sides of the car with their axes placed transversely. As in the Parseval airships, swiveling propellers are used. During one of her trial flights, the "Eta" went to the assistance of naval airship No. 2, which had broken down. The novel experiment of towing the disabled airship was made. In a recent number of *Flight*, a photograph was published which shows the disabled airship in tow of the "Eta." A difference in level of about 600 feet was maintained in order to avoid all chances of fouling the rudder gear.

Preventing the Dreaded Back-Fire.—One of the most formidable and greatly dreaded causes of accidents in flying machines is back-fire in the carbureter. As the result of an attempt to solve this serious problem an ingenious device has been invented by J. Holt Thomas. The instrument does not pretend to prevent back-fire, but is intended to prevent damage by putting out the fire before it can reach the gasoline tank and other parts of the machine. A two-way cock on the carbureter is connected with a lever normally held down by a fusible plug which melts at a temperature of 140 deg. Fahr. A plug fusible at any desired temperature may also be used. When a back-fire occurs the plug is melted and this allows a small steel spring to act upon the lever, closing the fuel line to the supply tank. It also opens, simultaneously, a vent which allows the fuel remaining in the carbureter to be drained to a point below the fuselage or to any point outside the danger zone.

The Jungfrau Railway

A Great Engineering Feat

ON February 21st, 1912, the tunnel beneath the "Monk" was completed to the Jungfrau Pass, and early in August the Jungfrau Pass station, the highest railway station in existence, was opened to traffic.

In 1893, when the Swiss railway king, Adolf Guyer-Zeller, proposed to construct a railway to the Jungfrau by tunneling beneath the Eiger and the "Monk," the scheme was deemed visionary and impracticable. Work was commenced in 1896, and in 1899 the first section was completed and put into operation. This section of 2 kilometers (1.2 miles), mostly above ground, connects the Eiger glacier station (elevation, 2,323 meters; 7,621 feet) with the Swiss railway station at Kleine Scheidigg (2,064 meters; 6,772 feet). At the Eiger glacier begins the great tunnel, with a mean gradient of 25 per cent, completed to its temporary terminus at the Jungfrau Pass. At a distance of 4.4 kilometers (2.7 miles) from Kleine Scheidigg and an elevation of 2,868 meters (9,409 feet) the tunnel grazes the northern wall of the Eiger, and here the rock-hewn station Eigerwand, which overlooks Grindelwald at the mountain's foot, was opened to traffic in 1903. From this point the tunnel follows a curved line to kilometer 5.7 and there expands to form the station Eismeer (elevation, 3,161 meters; 10,368 feet), which commands a wide view of the glacier and has been visited by thousands of tourists since it was opened in 1905. This station was the provisional terminus of the line until last August.

Work on the tunnel section of 3.5 kilometers (2.2 miles) between Eismeer and the Jungfrau Pass was commenced in 1907, by the excavation of a large machine room and a lateral gallery opening on the mountain side, for the removal of excavated material. For 3 kilometers (1.9 miles) from this point the tunnel runs in a straight line under the "Monk," with a gradient of only 6.3 per cent, so that tooth rails are not needed. In 1911 the work of ventilation and removal of material was facilitated by opening a lateral tunnel 200 feet long to the side of the "Monk." Here the tunnel resumes the gradient of 25 per cent, which is maintained up to the Jungfrau Pass (elevation, 3,457 meters; 11,341 feet).

Although the work was carried on day and night, the great elevation and the hardness of the rock limited the daily progress to about 12 feet. In some sections the gneiss resisted the hardest boring tools, but, in compensation, its solidity made all lining of the tunnel superfluous. The thin ridge which forms the Jungfrau Pass was approached with the utmost caution as it was feared that the glacier might be so deep that the tunnel might emerge from rock into ice. This fear was allayed by tentative borings, but the glacier was near enough to freeze the dynamite and lower the temperature of the workings to 20 deg. Fahr.

It had been calculated that the tunnel would be opened to the air at the Jungfrau Pass on February 21st, and the opening was actually made on that day. A week previously the workers had abandoned the head of the main tunnel, which is here expanded to form a terminus, and had proceeded to excavate a lateral gallery about 80 feet long which debouches on the glaciated pass between Jungfrau and the "Monk." This gallery connects the underground terminus with the station proper, which is here placed above ground on an artificial terrace in a spot reasonably well sheltered from avalanches. The building, which will be completed next year, will comprise several stories and will include, in addition to a waiting room and a restaurant, apartments for the personnel and also for tourists who wish to indulge in mountain climbing or to enjoy the winter sports for which excellent facilities will be afforded. A covered viaduct about 300 feet long, with a gentle upward grade, will lead from the building to a natural rock terrace bounded on three sides by almost vertical precipices, while the fourth side furnishes a direct and level passage to the wide plateau of the pass, where in the hottest day in summer visitors can wander over ice, snow and glaciers and enjoy skating and ski running, without danger or heroic exertion. A sledge road over the Aletsch glacier has been suggested, and even Guyer-Zeller's jocular proposal to maintain a regular summer service of dog sledges between the station and the distant Konkordia club house may be carried out.

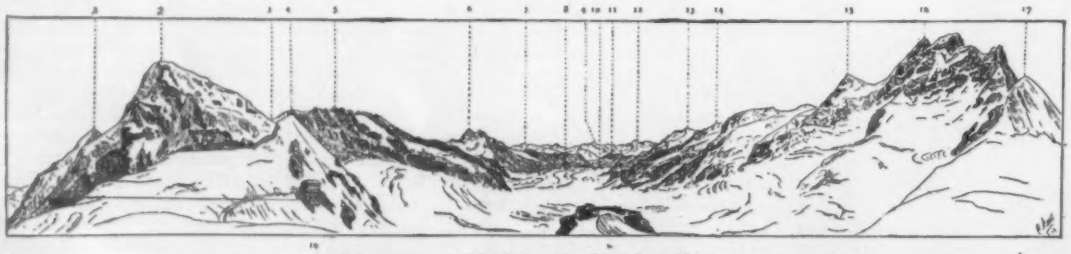
Arrival of the first train at the new station Jungfrau Pass. On the right, near the station house, the exit to the glacier.

The exit to the glacier.

The extension of the tunnel and railroad to the summit of the Jungfrau, about 2 miles beyond the pass, will not be undertaken immediately, as it has been found most profitable to prosecute the work by successive stages. The original plan contemplated the completion of the whole line in seven years, with an outlay of about 8 million francs ($1,544,000), but more than 10 million francs has already been expended, as the great tunnel has cost more than 1,000 francs per meter. The financial burdens have been materially lightened by the earnings of the completed sections. Furthermore, the concession for the section between the pass and the summit of the Jungfrau has expired, and the Swiss advocates of "conservation" oppose its renewal—unwisely, because the railroad will not injure the Jungfrau, but will merely make it accessible.

The ascent to the Jungfrau Pass on foot is seldom made, as it is one of the most dangerous of Alpine tours. The view from the pass is wonderfully beautiful and impressive. To the north it extends far beyond the glacier, which here makes its tumultuous descent to the valley. It includes the wide northeastern plain of Switzerland to the distant hills of the Schwartzwald and, in the foreground, Interlaken, Lake Thun, and the Lauterbrunnen valley. In the east the view is cut off by the upper pass and the sharp-angled pyramid of the "Monk," which rises almost vertically to an elevation of 4,105 meters (13,468 feet), while in the distance appears the peak of the Eiger (3,974 meters; 13,040 feet). In the southwest is seen an almost vertical cliff about 2,300 feet high on the eastern side of the Jungfrau, and the westward view is filled with the wild, irregular northeast ridge which extends upward to the summit, and which was ascended for the first time in 1911.

View showing an entrance to one of the stations in the new Jungfrau Railway tunnel.



Panorama visible from the Jungfrau Pass.

1. Eiger, 13,040 feet. 2. Monk, 13,468 feet. 3. Upper Monk Pass, 10,394 feet. 4. Sphinx, 11,729 feet. 5. Trugberg, 12,903 feet. 6. Kamm, 12,679 feet. 7. Scheinhorn, 9,652 feet. 8. Aletsch glacier. 9. Cherbadung. 10. Märjelen See, 7,710 feet. 11. Eggishorn, 9,626 feet. 12. Helsenhorn, 10,741 feet. 13. Dreichhorn, 12,549 feet. 14. Krausberg. 15. Rottalhorn, 12,946 feet. 16. Jungfrau, 13,668 feet. 17. Pic Mathilde, 11,681 feet. 19. Station Jungfrau Pass, 11,391 feet.

The view to the south is thoroughly Arctic. The Aletsch, greatest of Alpine glaciers, stretches down toward the Rhone valley, flanked by the snow-clad slopes of the "Monk" and the Jungfrau. The eye finds no green spot, no sign of life, and no human trace, except the Konkordia hut in the far distance.

This striking contrast between the smiling landscape in the north and the bleak desolation of rock, snow and gla-

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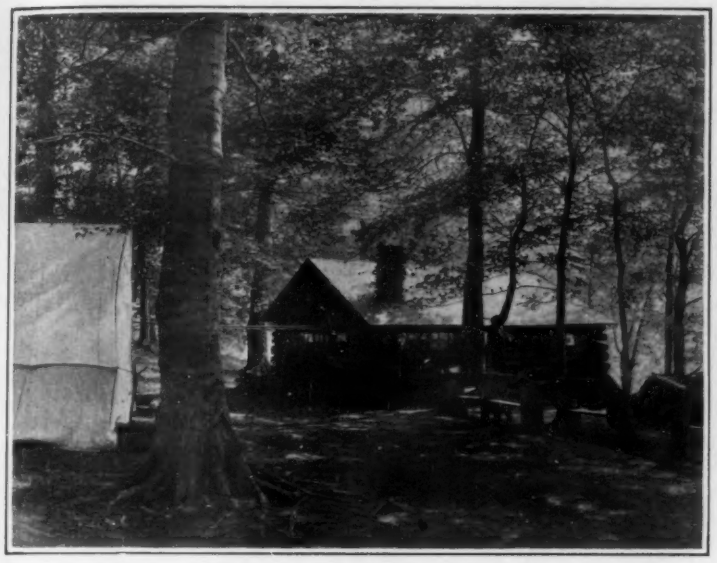

Tent and log hut at Interlaken.

Building their own home.

The Daniel Boone Idea in Education

A School System Based on Voluntary Muscular Work

ON the outskirts of La Porte, a small manufacturing town in northern Indiana, a group of thirty-five teachers and one hundred and forty boys are making an experiment in education. They live in a perfectly equipped school, located in the heart of an 800-acre farm. These teachers are all "cultured" in the conventional sense of the term; for they are the graduates of leading American or European cities. Nearly all the boys are sons of well-to-do parents and have known all possible comforts from their early days. Neither masters nor pupils, however, bear any external signs of a luxurious upbringing. Their khaki trousers, their leather leggings, their flannel shirts, their bronzed faces, their horny hands, their competent stride—all suggest rather the backwoodsman than the cloistered scholar. The average high school boy would probably sniff at the buildings of the Interlaken School, as the institution is called. Many youngsters spend the entire winter in log cabins; others live the year around in tents. The larger dormitories, rustic in their construction, are made of mammoth logs—in their appearance still suggestive, so far as possible, of the forests from which they have sprung.

Like many other modern improvements, the Interlaken School is a protest against accepted ideas in American education. That there is something fundamentally wrong in the present methods of bringing up children is now a settled conviction among thinking people. Perhaps that is due to the fact that life is now a very different thing from what it was fifty or a hundred years ago. Instead of walking we ride in automobiles or trolley cars; instead of cultivating our own food, we have it left at our doors in packages or cans; instead of weaving and making our clothes, as most American families did a hundred years ago, we buy them at stores. All these things mean progress; but every step forward in invention is also part of the general conspiracy that is being waged by modern industrialism against the individual.

Seventy-five years ago eighty per cent of our Americans lived upon the farm. The boy rose early in the morning and did the "chores." In spring he plowed; in summer he performed his task in open air work on the farm; in the autumn he helped to harvest the crops. In all cases he did real work—purposeful work that added to the world's wealth. Now the great majority of boys live in the town. Poor boys and rich boys spend but a few hours at school, more or less willingly; and when this ordeal is over they are left to their own devices. The fact cannot be escaped that the country boy is constantly using his hands, while the city boy is not. Most city boys could dispense with their hands altogether, and still perform their customary daily routine duties—except for the purpose of eating and dressing. But the human hand, after all is said and done, is of paramount importance. It was not until man began to use his forward members for other purposes than locomotion that he really began to progress intellectually. As long as the infant has to lie prone, its mental progress is extremely limited; as soon as it begins to creep and walk, its intellectual life begins to flourish.

We gain practically all our knowledge by the use of our hands and the rest of our muscular system as infants. There is not a single one of us who would have any first-hand knowledge of iron or any other metal unless we were able to take it into our hands. Our eyes tell us that it is gray in color, that it is crystalline, that its surface is smooth. All these things, however, might be equally true of painted wood. It is only when we take the metal in our hands, attempt to bend and to break it, that we really understand its nature. Not only do our muscles enlighten us as to physical facts; they interpret the deepest emotions of the soul. Pleasure, pain, agony, remorse—all these feelings find their appropriate spokesmen in facial expression.

It is a fact of the greatest significance for educators that the function of speech is localized in the third frontal left lobe of the brain, in close proximity to the motive center that regulates the right hand. Left-handed persons have the center of speech in the right lobe. In other words, the faculty of speech is closely related to the faculty that controls the hand. Both developed in the same parts of the brain. Teach a left-handed child to use its right hand and a bad case of stammering sometimes results. The two highest attributes of man—speech and the hand—seem to be really a part of one and the same intellectual faculty. Any attempt to educate a child without completely training the hand is fundamentally wrong.

Clearly, what we really need is something like the hand training that our boys used to get upon the farm—not the smattering of manual training such as most educational systems have introduced in recent years. In the old days the school could properly neglect this side of education and leave it to the home. But, as we have said, the old-fashioned home has disappeared. Unless the modern educational system, therefore, finds some adequate substitute for the muscular training of other days, its graduates will be only half men or half women. Not only is the body stunted, but the mind—for the mind itself really grows and develops as a result of muscular and especially of manual training.

It is to supply this need that the new schools have been established in Europe. In the founding of the Interlaken School the basis for an extension of this system to the United States was laid.

In the creation of the Interlaken School the boys have lived over the experiences of the early American pioneers. Ten years ago, the site of the school was a primeval wilderness. Early in June, 1910, the Interlaken boys, a hundred and twenty strong, invaded this neglected waste, armed with axes, carpenter tools, and above all, youthful enthusiasm for work and new experiences. The school had its inspiration in the principle that boys should regain the unique talent which their grandfathers possessed of doing things for themselves. What more appropriate beginning could they make than that of erecting their own school buildings with their own hands? That spring the boys spent making plans, calculating, estimating material, devising schemes of decoration, and outlining the work. No one was forced to participate; for the school theory is to make the work purely voluntary. The plan was to establish a summer camp on the site of the future school. All who wished to take their vacation in this way were invited to come

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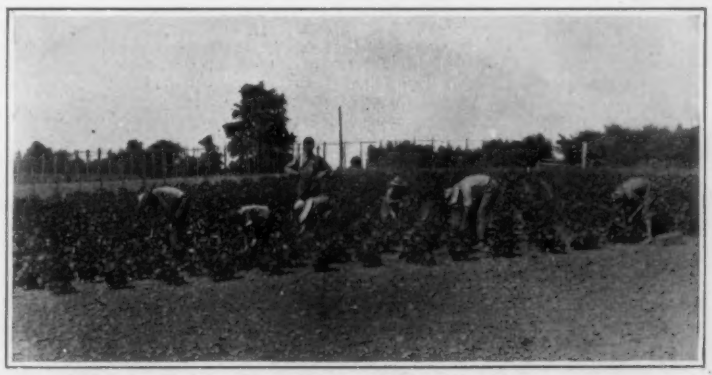
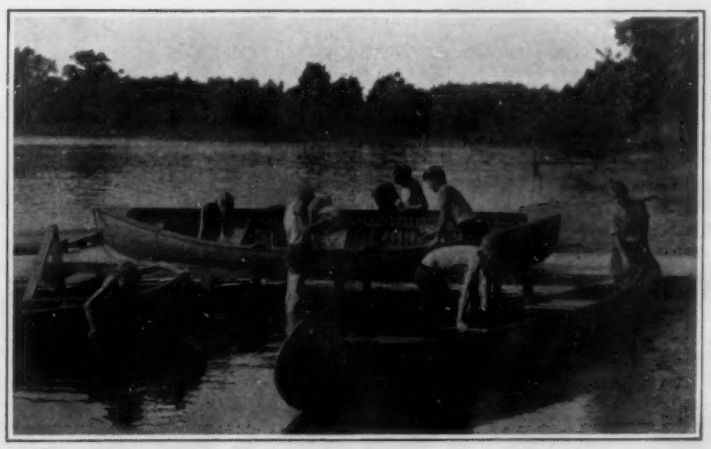


Training in husbandry.



Summer on the lake.

The Encyclopedia Americana Enjoined from using the Name "Scientific American"

SOME years ago the representative of a publishing house in New York called at the office of the SCIENTIFIC AMERICAN and laid before a representative of the company a plan for the publishing of an encyclopedia for the American people similar in scope and design to the Encyclopædia Britannica, only that it should be planned and carried out in such a way as to be of special value and interest to Americans. The project seemed to possess merit, and a number of interviews followed, during which the aid of the SCIENTIFIC AMERICAN was sought in preparing material for the new work, and finally one of the members of the company was invited to act, but entirely in his individual capacity, as editor in chief. A corporation was finally formed under the laws of the State of New York to carry out the work of publishing the Encyclopedia and placing it upon the market. This company was called the Americana Company. A contract was finally entered into with the SCIENTIFIC AMERICAN by which the literary end of the work should be conducted in the name of the Scientific American Compiling Department, and in the contract which was entered into, which was for a period of one year, and which was made renewable year by year, the Encyclopedia was sold to subscribers together with a year's subscription to the SCIENTIFIC AMERICAN, and in order to establish the connection the SCIENTIFIC AMERICAN conferred upon the corporation the right to use the title "Scientific American Compiling Department."

All the business of publishing the work and of placing it on sale was conducted by the Americana Company. A notable list of contributors was obtained, and from a literary point of view the work was satisfactory. For a long time the arrangement worked satisfactorily, but in the course of events complaints were received at the office of the SCIENTIFIC AMERICAN in which it was charged that the representatives of the Encyclopedia had been guilty of misrepresentation, and it was found that various abuses had crept in, which Munn & Co. seemed powerless to have corrected. Every effort was made to correct such mistakes and abuses, and, finally, the publishers of the Encyclopedia were notified that unless such abuses could be stopped altogether, the arrangement would be terminated.

About this time it was discovered by Munn & Co. that the publishers of the Encyclopedia were making plans to publish a Biographical Encyclopedia as an addendum or appendix to the main work. People of prominence, some of whom were well known to officers of this company, were invited to have their portraits published in this work, but they were at the same time invited to subscribe a generous amount in order that their biography might be embellished with a steel engraving of themselves. It was discovered that in some cases the canvasser who solicited these contracts held himself out to be a representative of the SCIENTIFIC AMERICAN. When this fact became known it was decided that the arrangement could not be continued and the officers of the company were notified that owing to the various abuses which had arisen, the name of the Scientific American Compiling Department must be withdrawn from the Encyclopedia and from all literature being sent out by the company. It was also discovered about this time that a new corporation had been formed which was known as the Americana Company of the State of Maine. This company had a capitalization of $1,500,000, and announcements appeared in the papers and magazines stating that the stock of the company was being offered to the public. Munn & Co. protested against the issue of this stock, and insisted that the use of the title SCIENTIFIC AMERICAN in conjunction with the Compiling Department must be discontinued. A number of interviews took place between the officers of the two companies, with the final result that the officers of the Encyclopedia Company refused to discontinue the use of the title Scientific American Compiling Department in connection with their campaign, and as a result the contract was terminated by the complainants at a meeting of the board of directors of Munn & Co. held in May, 1911, and in June, 1911, a resolution was passed directing the officers to engage counsel to bring suit against the Americana Company to enjoin them from using the title SCIENTIFIC AMERICAN, either in connection with the words Compiling Department or in any other way, and they were further directed to notify the Americana Company of this fact in order to give them a final opportunity of withdrawing without the necessity of a law suit.

No definite answer was received to their communication, but a few weeks later it was learned by the officers of this company that a new stock corporation was being projected and carried out by the Americana people. It appears that a corporation had been formed by them, but without the knowledge of the officers of the SCIENTIFIC AMERICAN, under the title Scientific American Compiling Department, with a capital of $2,000. In the autumn of 1911, after notice had been served of the impending injunction and after the contract had been terminated, the stock of this company was increased from $2,000 to $2,000,000, and by offering some stock as a bonus the stockholders of the Americana Company were induced to exchange their stock in the Americana Company for the stock of the Scientific American Compiling Department.

Papers in the suit were served upon the defendants in December, 1911, and the suit was tried in July, 1912, before Vice Chancellor Emery of the Court of Chancery of New Jersey. Notices warning the public of the suit were published in the SCIENTIFIC AMERICAN in 1911 and 1912 at regular intervals.

The opinion of the court has just been handed down, and it is sweeping in its character. It is very long and covers every phase of the case from the very beginning. It consists of over fifty pages of legal cap, or some 16,000 words. The history of the case from the beginning is carefully gone over and much space is given to unraveling the complicated relationship of the various companies under which the Encyclopedia was operated, which consisted of at least four different corporations with overlapping interests and responsibilities. The opinion of Vice Chancellor Emery states:

"The main object of the bill is to enjoin the use in any manner of the name "Scientific American" by any of the defendants in connection with the corporate title or with any of their publications. The complainants put their right to relief upon the grounds:

"*First.* That the right to use the name "Scientific American" was never granted to the corporate defendant "Scientific American Compiling Department."

"*Second.* That the name is a trade name of complainants, to which they have a property right, and which cannot be used by any of the defendants without consent, after the termination of the contract.

"*Third.* That the use of the name has subjected and will continue to subject complainants to loss, injury and damage, and is a fraud on complainants and on the public, entitling them to injunction and equitable relief.

. . . . . .

"The bearing of the matter of the extent of proof of confusion, loss or injury, or actual damage, on the main question now at issue, the further continuance of the name "Scientific American" in connection with the placing of the later editions of the "Americana" on the market, is in its effect as showing that so long as the use of the name is at all permitted, it will be impossible practically to prevent misrepresentations (intentional or otherwise) by the agents seeking subscriptions, or confusion in the minds of subscribers as to the present connection of complainants with the work and responsibility of some kind therefor.

. . . . . .

"Pending the running of the contract and partly by reason of the impression of complainant's connection with the work given by agents soliciting subscriptions, confusion occurred which required attention by complainants to claims involving financial responsibility for the contracts and representations of the agents securing them, as well as responsibility from a literary or editorial standpoint. . . . These claims, based both on financial and literary responsibility, were so frequent—every two weeks on an average—and of such a character as to impose upon complainants the burden of repelling or answering them in order to avoid claims of responsibility. This was of itself, in my judgment, an injury or damage to complainants in their business as publishers of the SCIENTIFIC AMERICAN, which could not be imposed on them without their consent and from which, on the termination of the contract, they were entitled to be relieved, except so far as it was the necessary result of the contract and their dealings under it. For six months previous to June, 1911, the date of actual termination of the contract, the complainants and the defendants, the Americana Company of Maine and the Scientific American Compiling Department, contemplated and prepared for the termination of the contract, the defendants requesting delay as necessary for the elimination of the "Scientific American" from the enterprise. As a part of this elimination complainants insisted on the abandonment of the use of the words or name "Scientific American" in the corporate name, or otherwise, but defendants insisted on the right to the continuous use of this corporate name as publishers of the "Americana," and since the termination of the contracts have continued this use of the corporate name.

. . . . . .

"This confusion requiring attention and action on the part of the complainants to avoid responsibility, has already, in my judgment, caused an injury and damage to the complainants in carrying on their business as publishers of the SCIENTIFIC AMERICAN newspaper, and is a confusion against the further continuance of which in the present and future publications of the "Americana" they are entitled to equitable relief as the only effective relief. The confusion results primarily and directly from the use of the complainants' well known and long established name SCIENTIFIC AMERICAN in connection with the name of publishers and sellers of a book of reference like the "Americana," including in its volumes scientific and other information, the collection and compilation of which the SCIENTIFIC AMERICAN has made a specialty for sixty years.

. . . . . .

"The public to whom the work is offered for subscription, are entitled to know that with the publication and placing on the market of the present editions of the "Americana" the publishers of the SCIENTIFIC AMERICAN have no connection or responsibility of any kind, financial or literary. To compel, or attempt to compel, specific explanation by soliciting agents, that the publishers of the SCIENTIFIC AMERICAN are not connected with the present publication of the work, or with the company itself, is, in my judgment, a futile and impracticable method, and the only certain or practicable method of insuring to complainants proper protection is that of enjoining altogether the further use of the name "Scientific American" in the corporate title and also enjoining its use in the publication or vending of the "Americana" of the editions of 1912, and any future editions except as hereafter stated."

The use of the title Scientific American Compiling Department was not only desirable, but the most convenient method of bringing before the public the literary connection of the SCIENTIFIC AMERICAN with the compiling of the Encyclopedia, but when the publishers of the former discovered that this name was being exploited in a manner not covered by the contract and not intended at any time of the negotiations, and that they had no control or power to correct these abuses; when it was discovered that the name of the SCIENTIFIC AMERICAN was being used to promote the sale of a biographical work of which they had no knowledge or interest; and when, lastly, it was found that the stock of the Encyclopedia was being placed upon the market under the name of the Scientific American Compiling Department, the publishers of this periodical having no interest in or control over these transactions, the only course left was to bring suit to enjoin the use of the name "Scientific American" in any and every connection with the sale of the Encyclopedia.

The decree of the Court was entered on October 28th, 1913.

Between Life and Death

ANABIOSIS, a state where all vital functions of the organism are suspended, without however death occurring, has been known for about 200 years, in the case of some of the lower animals, which can be dried and restored to life, even after a considerable time, merely by the action of moisture.

A Russian scientist, Prof. Bachmetief, has tried to ascertain whether phenomena such as these could not as well be observed in the case of higher organisms. While examining insects at decreasing temperatures, he found that the temperature of their body, after reaching the freezing point of water, would gradually fall as low as 5 deg. Cent. (in the case of some species even 7 deg. Cent.), in order afterward to rise one degree and eventually to continue falling regularly and gradually. Death would only occur at 10 degrees.

Prof. Bachmetief first thought death to be due to the freezing of humors, but he soon found that the humors of insect bodies already freeze at 5 deg. Cent., any vital function becoming impossible at this temperature. At temperatures intermediary between this point and the lethal temperature, a strange condition of anabiosis is produced, the organism being as it were between life and death. Animals in anabiosis have been repeatedly restored to life, even after a considerable time, by a gradual rise in temperature. This condition could be fitly compared with that of a clock with stopped pendulum, the mechanism of which could be, at any moment, started again by a slight impulse given to the pendulum.

These experiments were then extended to the case of some small-sized mammals (bats and white mice), which by the application of artificial respiration, could be reduced to some sort of lethargy, their body standing temperatures too low otherwise to be endured (0 deg. Cent., and less). Further experiments are to be made on higher animals.

The main purpose of the experimenter was to find a safe cure for tuberculosis. Applications of a mainly practical character, calculated to revolutionize some of our habits, are however likewise to be made. As regards the case of tuberculosis, it is well known that the microbes producing the malady will die or lose their powers of reproduction, on being submitted for two or three weeks to a temperature of 6 deg. Cent. If accordingly a patient could be kept at a temperature of, say, 8 deg. Cent., all Koch microbes would be safely killed or else rendered innocuous. On the other hand, Bachmetief is of the opinion that it would be advantageous to reduce to anabiosis, without any need of feeding them, such domestic animals as are unproductive in winter (bees, sheep, etc.), as well as those which are to be transported to considerable distances (cattle, fowls, fish, venison, etc.), in order to restore them to life whenever required. In order to begin with something practical, Bachmetief has applied his method with excellent results to the long-distance transport of caviar.

A New Scottish Antarctic Expedition is being organized. Its plans include the establishment of a base in Coats Land. A part of the expedition will winter here, and ultimately endeavor to cross the Antaretic continent to Ross Sea. Meanwhile, the rest of the expedition, after returning to Australia for the winter, will, if possible, effect a landing at McMurdo Sound in order to meet and aid the party crossing from the opposite side of the continent. Extensive oceanographic researches are to be carried out in the South Atlantic.

The Fire Control Platform of a United States Battleship

How the Telescope Sight, the Range Finder and the Spotter Co-operate to Secure Good Shooting

By J. Bernard Walker

IF we were asked to name the one particular mechanism to which more than any other is due the marvelously accurate shooting of heavy guns at the present time, we should unhesitatingly pronounce in favor of the telescope sight. Remove the telescope sights from the batteries of a modern warship, and the ranges would have to be decreased from twelve thousand to three or four thousand yards, and the shooting would be very indifferent at that. The modern system of fire-control is very elaborate, highly scientific, and dependent for its remarkable results upon the co-operation of many delicate instruments and the combined observations of several highly trained specialists. Remove from the system any one of these instruments or any one of the men concerned in its successful operation and the result would be impaired somewhat; but remove the telescope sights and you remove the whole thing.

Twenty-two years ago there was not such a thing as a telescope sight attached to a naval gun in the whole world. Ships' guns were using the old open sights, the one at the breech being adjustable to give the proper elevation to the gun. While striving to keep his eye in such a position as to maintain the two sights in line, the gunner awaited the critical moment when the roll of the ship brought this "line of sights" onto the target; and then he fired the gun.

About this time, or to be more exact, in the spring of 1890, a young officer of our Navy, Lieut. (now Rear Admiral) Bradley A. Fiske was aboard the U. S. S. "Baltimore," watching a test of his new electrical range-finder. During a delay in the firing, due to a flock of schooners having got in the way, he amused himself by looking at the schooners through the forward telescope of the range finder instrument, and noticed how definitely the cross hairs of the telescope moved across their sails with the gentle rolling and pitching of the "Baltimore." The thought suddenly struck him that anybody could fire all the guns in the broadside at that place where the telescope stood, and hit the target every time, by setting the telescope at the angle of depression equal to the proper angle of elevation of the guns, leaving the guns parallel with the deck and firing when the roll of the ship brought the cross hairs on the target. This line of thought ultimately led Lieut. Fiske to design a telescope which could be mounted on some part of the gun carriage that did not recoil, though it turned with the gun, the telescope being capable of depression with regard to the gun through a number of degrees corresponding to the degrees of elevation for a given range.

The idea was pooh-poohed, but the invention was patented nevertheless. A suitable telescope was then built, and applied to a gun on the gunboat "Yorktown," to which Lieut. Fiske had been assigned; and on September 12th, 1892, during practice carried out at Unalaska, Alaska, in competition with guns fired with the open sights, the new telescope sight proved its great superiority, to the astonishment of all on board, except the inventor himself.

The advantages of the telescope sight are many: It shows exactly, instead of inexactly, what the gun is pointing at; it wonderfully clears up the target; it enlarges the field of view over the old system some four or five times; it does not recoil with the target, and therefore the gun pointer may keep his eye constantly at the eye-piece; and, lastly, used in combination with the powerful and rapid gun elevating mechanism now employed, it enables the gun pointer to keep the cross hairs of the telescope constantly upon the target ship.

We mentioned above how it occurred to Lieut. Fiske that a telescope, set at the proper depression for the range, might be used at some definite position in the ship, and that from this station the whole battery might be laid in parallel and fired simultaneously by electricity, when the roll of the ship brought the telescope sight on the target. In 1890, Lieut. Fiske secured a patent on a method embodying this idea, and this method is what is known in modern days as "director firing." Some experiments were made in the British navy about the time that Fiske secured his patent. The idea remained dormant for many years, but it has lately been taken up, and brought to undoubted excellence by Admiral Sir Percy Scott, R. N., who recently told the writer that his system has increased the accuracy of target practice in the British navy by fully 100 per cent.

Our own Navy has developed its own system of director firing, the details of which are of course Department secrets. Such a system has been installed and recently tested on a vessel under the supervision of Lieut.-Com. B. A. Long.

Director firing is certain to become general among the navies of the world; and it is gratifying to know that our Navy, to which modern naval gunnery is indebted for the telescope sight, has secured excellent results in its first test of the latest improvement.

Under existing conditions, each gun is elevated by its own gun-pointer, who, with his eye at the telescope and his hand on the elevating gear, keeps the horizontal wire of his telescope constantly on the target. Our ships are securing wonderful results at target practice, as shown by the fact that the 12-gun battleship "Arkansas" recently returned to her home port, New York, with the following target practice record for one of her turrets: During one of the runs, the two 12-inch guns of No. 4 turret scored six hits in 57 seconds, the time being taken from the start of the powder and shell from the ammunition room below to the firing of the last shot of the six.

This fine work was done during target practice held for the purpose of selecting gun pointers, that is, the men who elevate and fire the guns.

The 12-inch gun is designed for a muzzle velocity with full service charges of 2,900 feet per second; but for this practice she was using reduced charges giving a lower muzzle velocity. The range was short; but because of the low velocity a fairly high sight bar range was necessary. Furthermore, the target was very small, being only one seventh of the area of the target used in battle practice at 10,000 yards, and it represented only about one fiftieth of the total projected area of a battleship.

The 12-inch gun is such a remarkably accurate piece that, if the distance to the target is known, and the sight setter and pointer are expert, the shell will find its way unerringly to the bull's eye. It will be understood, of course, that the three conditions named are not the only conditions affecting accuracy; since there must be taken into account the condition of the powder, the temperature of the gun, the wind, the density of the atmosphere, and other conditions which have their effect upon the flight of the projectile. But, broadly speaking, it may be said that if the distance, the sight setting and the pointing are accurate, a bull's eye will be secured.

Evidently, then, the fundamental necessity is to know the range or distance, and this is secured by the co-operation of two agencies—the range finder and the spotter. Now every school boy knows that the distance to an inaccessible object may be determined if we know the length of the base line and the two angles at the end of this line between the base and the distant object. Thus the surveyor measures a base line with his steel tape, sets up his transit at the ends of this line, measures the angles, and then, by a quick calculation, is able to determine the distance from the base to the object. Now the range finder is a most ingenious instrument in which the base line is measured, the angles observed, and the mathematical problem worked out, all automatically by the instrument itself, the resulting distance to the object being indicated by a pointer on a scale.

The range finder shown on our front page engraving contains two object glasses, one at each end, directed toward the distant ship, and on the opposite side of the tube, at its center are the eyepieces for the observer. The image of the ship that is received through the right hand object glass, is seen by the observer in the upper half of the field of the eyepiece. The image coming through the left hand of the glass is seen on the lower half, and the images represent, respectively, the upper and the lower half of the ship. The right hand of the observer holds a little thumbscrew, which serves to move transversely along the axis of the tube a prism, which intersects the rays of light that have been deflected by the prism at the end of the tube, and are passing to the central eye-piece. When the range finder is "out of focus" so to speak, the two halves of the ship will not be properly aligned, and the observer brings them into focus by turning the thumbscrew. When alignment has been secured, the observer looks at a small horizontal scale on which the exact distance of the ship is indicated by the triangular pointer shown in our illustration.

The range, as thus determined, is telephoned to the fire control station below deck, where certain corrections are made, the corrected range being then telephoned to the sight setter at the gun.

Even though the sight setter sets his sight bar correctly, and the pointer fires when the horizontal wire of his telescope is exactly upon the center of the target it may yet happen, that because of, let us say, refraction due to the condition of the atmosphere, the fall and splash of the shot may be a couple of hundred yards over or short of the target, necessitating a further correction. This correction is made by the spotter—the officer shown in our front page engraving with glasses in his hand, and telephone clamped over his ears. Through his glasses he estimates that the splash is, let us say, 200 yards short of the target; and immediately he calls into his telephone mouthpiece, "200 up" meaning that the sight bars must be raised to an extent corresponding to 200 yards in range. From this time on, during the firing, the judging or correction of the range is in the hands of the spotter.

Electrolytic Production of Oxygen

CERTAIN industrial applications of oxygen, such as autogenous welding by the blowpipe, require the use of a very pure gas, owing to the fact that impurities cause a lowering of the flame. The production of oxygen by distilling liquid air does not allow of entirely eliminating the nitrogen, and the best rectifying apparatus give a product which still contains from 1 to 1½ per cent of nitrogen. The electrolytic process appears to be better for this purpose, and it allows of more easily obtaining oxygen at 99 per cent or even more. The improved apparatus now produce crude gases such as oxygen at 96 to 98 per cent and hydrogen at 98 or 99 per cent, and the gases are then rectified. In the Schuckert electrolyzer which is designed for this use, the gases coming from the electrolysis are collected in bell-shaped vessels. The elements of the apparatus are constructed so as to support variations of current within the limits of 2.5 to 4 volts without producing any detrimental effect on the purity of the gas. It is found that the oxygen which is produced in this way does not contain more than 2 to 4 per cent hydrogen for the crude gas, and the hydrogen contains less than 1 to 1.5 per cent oxygen. The mixtures of the two gases occur to a slight degree owing to the movements of the bath and the diffusion of the gases, and the amount of impurities increases as the electrodes come nearer together. But as it is required to keep the electrodes rather close together in order to reach the maximum yield of gas, some degree of mixture of the gases must be allowed. A remedy was sought by putting in porous partitions in cement or asbestos, but these required much attention and raised the upkeep cost.

The iron anodes are protected by a deposit of magnetic iron oxide which prevents their being attacked by the oxygen. In the bath, the presence of impurities such as chlorides, sulphates, and the like is to be avoided, as they would give rise to ferric hydrate partly in suspension in the liquid and in part deposited on the cathode, which would require an increase in voltage. Caustic soda is used in practice for the bath, this not containing more than 0.1 per cent of sulphates, nitrates or chlorides. The gases produced by the apparatus are sent at first through a vessel containing coke which is sprinkled with water, and here the particles of caustic soda which are drawn over are absorbed. To eliminate gaseous impurities, combustion is set up with a part of the oxygen and the 2 to 4 per cent of hydrogen which it contains, and the hydrogen in turn is purified in the same way by burning out the oxygen. This action is produced by passing the gas through a silver tube which is heated to low redness by an electric current passing in a platinum spiral. The tube contains pumice stone treated with palladium. This method has the advantage of preventing explosive mixtures which might be formed, for instance, should the poles be accidentally inverted, and such mixtures cannot reach the gas holders. As the heating is done by the current from the main apparatus, the heater starts up as soon as the gas flows.

Practically all the expense in the electrolytic process lies in the cost of electric current, as the apparatus is automatic and needs but little attention. All that is needed is to add a certain amount of water once a day, this being 2 cubic feet of water per foot of oxygen or per 2 feet of hydrogen. Circumstances decide which is to be preferred, the air distillation or the electrolytic method. The air process needs a less amount of power, but requires constant watching and experienced labor. It being in fact more expensive than the other when it comes to small plants. Besides, the starting up of the apparatus requires two or three hours, in which time it is not productive and consumes power, so that such plants should be run continuously as much as possible. On the contrary, the electrolytic apparatus can be started and stopped at any time without drawback, and it is also able to work on variable currents.

The Completion of the Los Angeles Aqueduct

Bringing 265,000,000 Gallons of Water Per Day 234 Miles From the Sierras to Los Angeles

By Henry Z. Osborne, Late President Los Angeles Chamber of Commerce

Section of an eleven-foot steel siphon.

A drive through the aqueduct.

Smooth-finishing a conduit.

OWENS River Valley geographically is more of a Nevada valley than one of California. The river from which it takes its name, in its southern course parallels the main range of the Sierra Nevadas, and has its source in and derives its waters from these grand mountains. The snowfall is extremely heavy in the high eastern side of the Sierras, and nearly every canyon that leads steeply down to the plains of Nevada and the adjoining Inyo and Mono counties, in California, carries fine streams of water throughout the year, which streams are veritable rivers in the spring and summer months when the winter snows are melting. Thirty-five such streams empty into the Owens River from a drainage area of 2,800 square miles. The length of the river is about 150 miles. Its waters are made up altogether of the snow waters from the Sierras. The valley itself is from two or three to ten miles wide, and sufficient water flows in the river to irrigate all this valley, with an overflow into Owens Lake, area 75 square miles, where it performs no useful service, of sufficient volume to supply a city of two millions of people with an ample quantity for domestic use.

It was to this grand source provided by bounteous nature that Los Angeles turned, when it was foreseen that in the course of its rapid growth there might be a shortage in the indispensable water supply.

A former city engineer and subsequent mayor of Los Angeles, Fred Eaton had spent some years of his earlier life in the Owens River Valley of Inyo County, and to his alert mind probably first occurred the idea of Owens River as a source of the permanent water supply of Los Angeles. He presented the subject to the Board of Water Commissioners and to Chief Engineer William Mulholland, and the latter was sent with

Building a reinforced concrete siphon.

Mr. Eaton to look over the ground. Upon his return a favorable report upon the project was made by Mr. Mulholland, who in 1906 prepared plans and estimates for an aqueduct to bring 265,000,000 gallons daily to the city, the cost of the work to be $23,000,000. The plans were approved by a board consisting of John R. Freeman, James D. Schuyler and Frederick P. Shearns, and the citizens by a popular majority of 10 to 1 voted in favor of construction, and work was begun.

Two years were exhausted in finding the best and most feasible route, which was often changed by Mr. Mulholland and his chief assistant, Mr. Lippincott, for economic or other good reasons. Fourteen months were required for the enormous preparatory work. So that, with the exception of some work at the Elizabeth tunnel and at the intake, the actual construction work of the aqueduct commenced in October, 1908. The wisdom of thorough preparation even at the cost of considerable time was fully vindicated by the rapidity and certainty with which it proceeded from that time.

The Aqueduct.

The intake of the Los Angeles aqueduct, which is constructed of concrete in the most solid and substantial manner, is situated thirty-five miles above the mouth of the Owens River; this to insure against the possibility of alkali solutions. Its elevation above sea level is 3,812 feet. The dimensions of the aqueduct vary greatly on different parts of the work, depending upon the physical nature of the country through which the water is passing. The first 22 miles is a canal, 62 feet wide at the water surface, 38 feet wide at the bottom and 10 feet deep, uncemented, and at a slightly higher elevation than the river. This canal was excavated by three electric dredges.

At the Alabama foot-hills the aqueduct is conducted

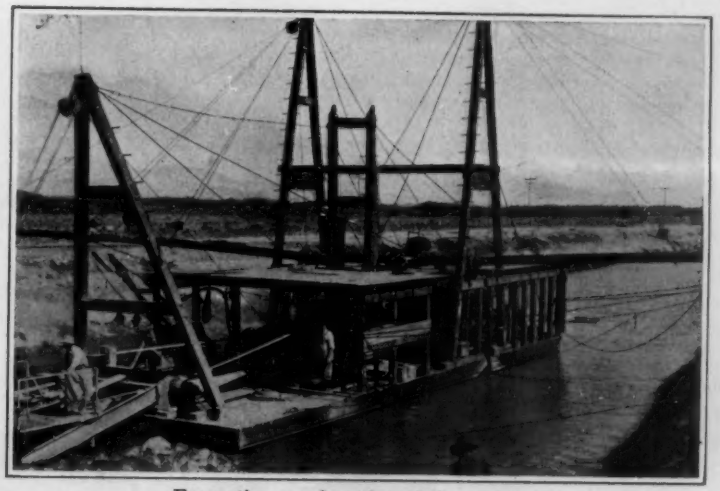
Eastern slope of the Sierras, the watershed of the Owens River.

along the mountainside, passing Owens Lake on its western side and about 200 feet above the surface. This part of the aqueduct is concrete lined, 30 feet wide, 12 feet deep and 38 miles long to the Haiwee reservoir, the first of the five great storing basins. This upper portion of the aqueduct, to Haiwee reservoir, is the only portion uncovered. All the remaining conduit is covered with reinforced concrete slabs six inches in thickness. The conduit is lined with concrete from eight to twelve inches in thickness. South of Haiwee reservoir the size and shape of the aqueduct vary considerably, and they were determined by the topography of the country and the character of the soil. The average size is twelve feet wide and ten feet deep.

The Tunnels.

The enormous amount of tunnel work, the great length of the tunnels and the rapidity with which they were driven, constitute one of the most notable features of the aqueduct. All told, there are 150 tunnels on the line, varying in length from 100 feet to the great Elizabeth tunnel, 26,870 feet, or over five miles, long. All world records for tunnel construction were broken in this tunnel. The estimate of the Board of Consulting Engineers was that one year's time would be required for preparation, four years for actual construction, and $1,913,000 to cover the cost. Work was commenced simultaneously at both ends of the tunnel, October 5th, 1907, and 250 men were employed night and day in boring the mountain. An average rate of 11 inches per hour was made throughout, and the tunnel was completed February 28th, 1911, in a period of 3 years and 7.3 months and at a cost of $500,000 less than the estimate. It is the second longest water tunnel in the United States.

From tunnel to siphon.



Excavating canal section of the aqueduct.

Concrete flume used across small gulches.

Carrying water, provisions and dynamite through the mountains.

Steel siphons carry aqueduct over canyons.

The total length of tunnels on the aqueduct is 52.035 miles, of which 42.903 miles is on the main aqueduct, and 8.906 miles on the power system.

The Reservoir System.

There are five reservoirs on the line of the aqueduct, the largest being the Haiwee reservoir, which is intended for storage, clarification and regulating purposes. The capacity of the canal and cement-lined conduit leading to this reservoir is 500,000,000 gallons per day—about twice the capacity of the aqueduct below that point. It is made so large for the purpose of carrying the excess flow during the melting season and accumulating a large reserve. The reservoir, which occupies a former channel of the Owens River, is now a large lake seven miles long, with an area of 15 square miles, and a storage capacity so large that in case of emergency it would amply supply the city of Los Angeles for three years. The Fairmont reservoir is 127 miles south of the Haiwee reservoir. Its purpose is for regulation rather than storage—its capacity being limited to ten days flow of the aqueduct. Its purpose is to regulate the flow into the Elizabeth tunnel, through which the water will flow to the seaward side of the coast range. The reservoir covers a surface of 165 acres.

The Dry Canyon reservoir is a small reservoir, a few miles from the terminus of the aqueduct.

Two reservoirs are in course of construction in San Fernando valley, at an elevation of from 1,100 to 1,200 feet above the city. They will impound the water just below the outlet of the aqueduct, and regulate the distribution. These two reservoirs mark the end of the Los Angeles aqueduct proper. At the recent bond election, held April 15th, 1913, the city voted $1,500,000 additional bonds, to construct a trunk line from these reservoirs, 28 miles to the city limits, where it will connect with the city water mains.

Crossing the Valleys.

While the boring of the mountains by tunnels is sufficiently difficult, the task of carrying a great flow of water across the valleys is little less so. In many instances it is much more difficult. In some places this crossing was done by building the conduit of solid cement, supported by columns and abutments of the same material. More frequently, however, the valleys are crossed by means of very large steel siphons, with a diameter of from 7½ to 11 feet, built to stand a pressure up to 350 pounds to the square inch. There are on the line twenty-three of these siphons, with an aggregate length of 12.06 miles, crossing as many canyons. The only rock siphon on the line—that at Sand Canyon—on trial failed to stand the pressure, and is now being rebuilt of steel.

Aqueduct Work Classified.

A classification of the work as it has been carried out, extending from the inlet gates to the outlet on the rim of the San Fernando Valley, includes the construction given on page 371.

Generation of Electrical Energy.

Aside from the sale of water for domestic use and the surplus, which for many years will be large, for irrigation purposes, it is anticipated that the most prolific source of revenue, with which to meet the principal and interest on the bonds which have been and will be issued for the construction of the Los Angeles aqueduct, will be the sale of electric energy produced by the water of the aqueduct in its descent from an altitude of 3,812 feet at the intake to its outlet in the San Fernando valley, 1,461 feet above the sea level. The construction of the power plant is an independent

(Concluded on page 371.)

Hugh Lincoln Cooper

The Man Who Built the Keokuk Dam Across the Mississippi

By Will P. Green

PERSEVERANCE is the keynote of the success of Hugh Lincoln Cooper, chief engineer of the $27,000,000 power development dam across the Mississippi River at Keokuk, Iowa. Cooper persisted in pushing the Keokuk project to completion when men of less determination might have abandoned their plans, with the result that to-day the concrete monolith stretching from the Illinois to the Iowa shore stands not only as a monument to engineering skill, but also to the tenacious spirit of American engineers.

Mr. Cooper states that fifty-eight capitalists showed him out of their offices before one man could be found with the confidence to invest his money at Keokuk. Many of them knew that the necessary power was in the Mississippi, and most of them were acquainted with Cooper's standing as an engineer. Investigation, on the other hand, and opinions from eminent engineers, were to the effect that conditions at Keokuk were peculiar to the extent that a turbine wheel never had been built to meet them. "That's all right," was Cooper's answer. "Then we'll build one ourselves." And he did, designing a turbine wheel specially suited to the conditions; and when the plant is entirely completed, thirty of these wheels will be developing the maximum power of which the Keokuk dam is capable.

When Cooper finally found money to finance the Keokuk project, it was not American capital. Englishmen, in fact, seemed to have the greatest confidence in the ability of the American engineer. They had seen him drive a tunnel under the center of Horseshoe Falls at Niagara, and in addition to that he had built a number of great water power plants in foreign countries, among them Brazil, Mexico, and Jamaica, and one at McCall's Ferry on the Susquehanna. The total amount of capital showed that sixty-five per cent of it came from England, France, Canada and Belgium, and thirty-five per cent from the United States.

In constructing the Keokuk dam Cooper was confronted with some stupendous problems; an instance of which was the battle with the ice during the spring of 1912. From the beginning of the construction period it was evident that the worst conditions would be met by the Iowa cofferdam when the ice went out. Cooper kept this constantly in mind when he designed the cofferdam, and the methods of meeting the attacks were thought out far in advance of their coming.

The ice in the Mississippi usually breaks up in March or April, and moves down the river in large cakes, often 400 or 500 feet square. As it floats down stream, the contact with warmer water and numerous obstructions usually breaks it up into a mass of smaller pieces. The momentum and pressure of thousands of tons of ice thus passing down a river it is difficult for the layman to comprehend.

In the spring of 1912 the construction had so far progressed that there was a clear space between the dam as it had been completed from the Illinois side and the Iowa cofferdam of about 450 feet. The openings of the bridge piers were closed so that all of the ice was forced to pass out through the single opening between the end of the dam and the cofferdam.

The Iowa cofferdam consisted of a transverse line of cribs at the north end of the power house site, extending out about 1,300 feet into the river. The cribs had on their outside face a line of vertical plank sheeting, and outside of this a clay embankment. The upstream side of the embankment had been covered over with loose rock to obviate the scouring action of the current. At one corner of the cofferdam a wing of cribwork was built to throw the current out nearer the center of the river. In preparation for resisting the ice action it was expected that ice floating down the river would strike the upstream leg of the cofferdam, being thrown up on the inclined surface of the rock-protected fill and forming in itself a barrier to deflect the ice following out into the middle of the river.

The ice was from two to three feet in thickness, and so late was the spring that Mr. Cooper figured that a large quantity of ice probably would be released at one time. In order to afford additional protection, additional cribs were built, armored with boiler plate. Part of the crib construction was built four feet higher and loaded down with rock.

The first break in the ice lodged quite a field of it in the opening between the Iowa cofferdam and the Illinois cofferdam. Men were on duty day and night to patrol the cofferdam and to watch for developments. It was 2 o'clock on the afternoon of March 23rd when the ice above the cofferdam really broke and started downstream. As had been expected, the advance floes piled high on the inclined face of the cofferdam, finally piling back on the ice following and forming a great bank. Great quantities then began to wedge through the opening in the river. The entire defensive construction withstood the attack perfectly.

But a gorge soon formed several miles down the river, and the stage of water at Keokuk went up to a point higher than the cofferdams ever had been called upon to withstand. The gorge broke, and the river fell. Again a gorge formed, and the river rose to seventeen feet. The cofferdam was designed for a twelve-foot stage; but the filling had been carried up so that it really was good for sixteen feet. Cooper ordered the cofferdam raised higher still, and night and day steam shovels and a force of men kept pace with the rise of the river. For two weeks a flood stage ensued. Danger points appeared almost without warning, and prompt action was always necessary. When the water was at its highest, windstorms threatened to undo all precautions that had been taken. On April 7th, with the water at 18 feet, and only a thin wall of earth two feet wide protecting the cofferdam space from being inundated, a severe storm came up about midnight. Waves dashed over the earth embankment, and the end seemed in sight. Cooper was there personally directing the fight. His men were holding the bank with sand bags. Fifty men were not enough. A call was sent for 100 more, and by morning the dangerous stretch of the cofferdam was covered by a great mound of sand bags. The river then began to fall, and the fight had been won.

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Hugh Lincoln Cooper, C.E.

Who designed, financed and built the great Keokuk dam across the Mississippi.

Hugh L. Cooper was born in Houston County, Minnesota, and he was still in his forties when he built the Keokuk power dam. As a boy he grew up with water wheels. His schooling was limited, and observation made up the greater part of his education. His father was a water-wheel owner and builder, and the boy early evinced a keen interest in the engineering side of the work. His first real work was with a bridge construction company, but Cooper always had hydraulic engineering in mind, although his initial work as an engineer in business for himself was in the construction of a bridge in Washington.

Later he went to foreign fields. Cooper has a great respect for foreign labor, and even now he stops with interest to watch a Slav or Balkan on the job. The countries in which he worked have already been mentioned. He returned to America to build at Niagara, and later on in the Mississippi.

After completing the project at Keokuk, he decided to take a six months' vacation in Europe, and there he is at the present time. This master engineer shrinks from publicity. When the great Keokuk dam was dedicated, he was among the missing. Purposely he wanted to avoid the notoriety connected with it. His personality is attractive, and many lessons may be learned from his methods. His success engenders in the mind of the American public an added respect for our American engineers.

Treating Deafness by Electricity

THE partial deafness connected with inflammations of the middle ear is considered incurable in many cases, and patients must be content with getting rid of the original affection (suppuration of the middle ear, etc.). As regards otosclerosis, both the affection and the concomitant deafness may be said to be incurable.

Dr. Hamm, an ear specialist of Brunswick, Germany, has devised a new method for healing partial deafness in such cases, especially in young people, by electric heat effects (diathermy) on the tissues of the ear, by means of a special device designed by Prof. Peukert of the Brunswick Technical High School.

The *ototherm*, as the new apparatus is called, comprises two disk electrodes—one of which is fixed and the other rotatable—connected up to a circuit into which a capacity and a self-induction coil are inserted. The two electrodes are arranged in front of each other, at a distance of a fraction of a millimeter, the interval being taken up by a layer of oil or alcohol, renewed by a continuous supply of liquid. The movable electrode is set rotating by a small electric motor. The two electrodes are surrounded with a sheet metal cover, preventing any projection of oil (or alcohol). A continuous or alternating current tension connected up to the two electrodes, of course, produces in the oscillatory circuit alternating currents of very high frequency, the number of cycles of which is controlled by choosing a proper capacity and self-induction. The self-induction coil is coupled to another coil in which high frequency alternate currents of a tension depending on the number of spires of this coil are produced. The effect of mutual induction between the two coils is controlled by varying their degree of coupling, i. e., by inserting them to a variable distance into each other. The terminals of the second coil are connected up with the electrodes, one of which (a light brass electrode coated with deer skin and moistened with warm water) is, before starting the apparatus, cautiously introduced as far as possible into the external part of the ear to be treated. The heat generated by the high frequency currents is controlled in as simple a manner as possible by shifting the coils, and is increased as far as the patient is able to stand it. The consumption of energy of the apparatus is extremely low; the ototherm is connected to any socket like an electric lamp. The degree of heat which can be endured by the patient varies from one person to the other, being even different for the left and right ears, respectively. The duration of a sitting is for each ear five to ten minutes, and the number of sittings one to three per week. Some cases are cured in a fortnight by four to five sittings, whereas others require a treatment lasting several months. Any cases susceptible of being cured by this method show already after the first sitting a notable improvement.

In view of the satisfactory results obtained in a number of cases, Dr. Hamm does not hesitate to declare that ototherm is a therapeutical process, allowing chronical affections of the tympanum and chronical inflammations of the middle ear (*otitis*) to be cured. It affords a means of combating the partial deafness consecutive on suppuration of the middle ear, even in case this requires an extensive surgical operation. Ototherm simple or combined with fibrolysine treatment, would also seem at least to improve certain cases of otosclerosis.

Finger Print Detection by Chemical Means

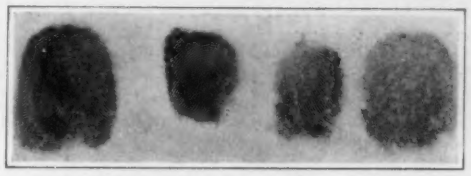
By "Delta"

THE common method of making finger prints clearly visible is to sprinkle talcum powder, or aluminium powder or a preparation of chalk and mercury over the suspected spot, and then brush the spot slightly with a soft camel's hair brush, when the lines of the finger tip show up in white. The writer has recently discovered another way to secure these impressions in black or brown black, by chemical means. If a finger print is made upon a piece of hard-surface paper, or an impression of the thumb or both, a very fine powder of dried acetate of lead may be scattered over the places where these impressions have been made and then the paper should be tapped so as to free the surface of the superfluous powder, after which the spot should be submitted to the fumes of sulphide of ammonium. The markings will then develop immediately into bold clear lines of a brown black color, due to the formation of sulphide of lead.

If finely powdered dry chloride of silver be used instead of acetate of lead, the sulplus powder being removed in the same way by tapping the paper, it will be found that on exposing the paper to the action of light (sunlight if possible) the finger prints will develop perfectly. Of course from these developed impressions a negative may be made and prints made therefrom, either by direct printing, or by development.

It has been found by testing that if the paper employed for this class of work is coated with plain collodion so as to make it non-absorbent the impressions become very brilliant, and can be fixed by floating the paper back down upon a mixture of sulphuric ether and alcohol in equal parts, the penetration of which softens the collodion surface, causing the sulphide of lead, or reduced silver chloride to adhere. A finger print upon a glass tumbler, a glass pane, or upon office brass work can be brought out distinctly in black by placing a piece of white paper in the tumbler in cylinder form. A negative can be readily made from the impression. Acetate of lead appears to give blacker impressions with the sulphide of ammonium. The accompanying photographs show finger prints rendered visible by sulphide of lead and by chloride of silver developed by light.

Finger prints rendered visible by sulphide of lead.



Finger prints developed by light after treatment with chloride of silver.

How Telegrams are Sent in China

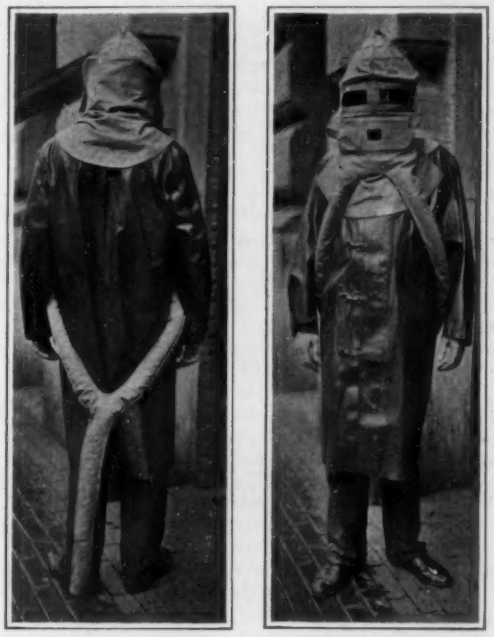
By R. E. Chambers

THE Chinese written language has several hundred thousand different characters. None of these can be spelled so as to indicate accurately how they are pronounced. Besides there are hundreds of ways of pronouncing each character, as there are hundreds of spoken dialects in China, although the book language is the same throughout the country. How is it possible to send a telegram in such a country and in such a language? The difficulties have been overcome, and it is really less trouble, and less expensive to send a message in Chinese than in English.

The telegram published herewith will help to make the matter plain. There is in every Chinese telegraph office a special dictionary, or catalogue, or code book, whatever you may choose to call it, in which the characters are numbered from one on up. A total number of 9,999 may be catalogued under the present system.

Chinese telegram showing the number code.

A certain number of blank spaces have been reserved to add special characters from time to time. The sender of the telegram simply writes his message in the usual way. The operator will probably know the numbers of most of the characters. If not he can readily find them in the catalogue. For each character he sends five Morse signals, e. g., 5913, 0013, 0414, which represent the characters "Yuan Shi Kai," the name of His Excellency, the president of China, who sent the telegram here reproduced. It will at once appear that only ten different signals are needed for telegraphing 9999 different characters in Chinese. By splitting up an unusual character into its common parts it may be easily sent. Private codes are readily prepared with this system. Already the chief cities of the country, and many small places have telegraph offices. It is hoped that under the republican form of government the whole service will be extended, improved and made less expensive. It may be of interest to mention that the telegram published herewith is an appreciative reply of President Yuan to a telegram which the writer as president of the China Baptist Conference sent to him upon the occasion of the call for special prayer for China. In addition to the ordinary wire service, China now has several powerful wireless stations, and arrangements are being made to cover the country with them.



Fireman's smoke helmet with intake near the floor.

Transforming a Schooner into a Grain Lighter

SHORTLY after the directors of the port of Boston succeeded in getting the Hamburg-American Line to shift a part of its business to Boston, it was discovered that there was no grain lighter in the harbor with sufficient elevation to load the new liners.

In this emergency the schooner "Ellen M. Golder" was secured and practically stripped. She is 163 feet long overall, by 35-foot beam and 650 tonnage. Bins with a capacity of 22,000 bushels were built in the hull, An engine was then installed in the stern and geared to a shaft running forward to a point about half way to the bow where a rope sheave transmitted power to the head shaft of the two main 20-inch bucket elevators, 70 feet above the deck.

At two points between the engine and the rope drive, power is taken off through gears—at one point to drive two cross shafts provided with niggerheads which serve to move the lighter backward or forward to a better position to load, and at another to drive a vertical shaft which in turn operates a secondary shaft running lengthwise of the schooner. The latter serves at each end as a head shaft for the two 16-inch distributing elevators.

The lighter is loaded to its full capacity at a grain elevator and towed alongside of the liner to be loaded. The capacity of the lighter is equal to a day's work for the main elevators which draw from the bins amidships, and the smaller distributing elevators fore and aft deliver grain to the main bins at a rate which insures all the hoppers' emptying simultaneously.

Smoke Helmets for Firemen

By J. R. Schmidt

THE helmets pictured herewith enable a fireman to remain in a smoke filled room for an indefinite length of time without resorting to the use of oxygen tanks to sustain life. They have recently been adopted by the fire department of Cleveland. The new device consists of a canvas hood, somewhat similar in appearance to a diver's helmet, with mica squares admitting light. This fits closely over the head and shoulders. From it trails a hose which reaches down to the floor, through which air is carried to the wearer.

As heated smoke, fumes, etc., have a tendency to rise, there is, ordinarily, more free oxygen in the smoky room close to the floor. In walking around in a smoke filled room the wearer of the helmet breathes the air taken from the floor by the trailing hose. Air valves in the top of the helmet afford escape for the exhaled air so that a fresh supply is always received from the floor. To prevent the hose from collapsing a spiral spring runs its entire length and a heavy end keeps the hose always near the floor. Experiments have shown that a person can remain in a smoke laden room for 20 minutes after the end of the hose is closed. The advantages of this helmet are that it dispenses with heavy oxygen tanks and may be worn by man or woman of any size, to whom it may be adjusted in less than a minute's time.

The French Prohibition of Inflammable Celluloid Films

AFTER December 1st the ordinary celluloid moving picture may not be used in France. Instead an uninflammable film must be used. Thomas A. Edison issued the following statement when informed of the new French law:

"There is no possible material known that takes the place of the present celluloid film. In this country the insurance companies have been so strict that everything pertaining to the film and machine is incased in iron and asbestos so that the chance of a fire is reduced almost to immunity. Out of 13,000 moving picture theaters we scarcely ever hear of a fire, although the theaters are running almost continuously. The amount of film stored in the fireproof booth at any one time is so small that it is difficult to imagine any danger to the theater even if the whole amount should burn up. A properly designed machine provides immunity aside from the fireproof booth."

Schooner converted into a grain lighter.

What Are the Ten Greatest Inventions of Our Time?

The Second Prize Article in the Scientific American's Invention Contest

By "Altair" (George M. Dowe, Washington, D. C.)

WHEN one considers the vast number of inventions of our time, and endeavors to compare them as to their relative importance, there is suggested to the mind, as a basis of comparison, the inventions of other times, and also the question of the origin of inventions generally.

We may perhaps be accustomed to think that all inventions are of comparatively recent origin, but a glance at man even in the savage state, will indicate that such is not the case.

In man's earliest struggles for the means of subsistence, he was obliged to invent some means to aid his natural powers in procuring his food, his shelter, and his clothing, or else lose in the race with other animals contemporary with him, and many of which were more powerful than he. This conflict arose from the beginning. Man could not fly, like the birds he sought for food; nor burrow like the bear, whose skin he coveted for a cloak. His problem was to invent missiles that could move faster than the objects of their pursuit, and to create tools for digging and compel burrowing animals to quit their dens. As the modern inventor is ever seeking to improve the instruments he uses, to adapt them more perfectly to his needs, so the genius of early man was engaged in adding speed to his feet, momentum to his fists, and strength to his grip.

In one aspect then the history of humanity may be viewed as the history of the development of man's inventive faculty, and thus viewed man has been an inventor from the earliest times and inventions have been made in response to needs; in the desire to bring about larger results by less expenditure of effort.

The most impelling of the needs which have stimulated the exercise of the inventive faculty, have arisen from the desire for food, the desire for shelter from the elements and the desire for rest and bodily comfort; and while few and simple in savage times, and wonderfully numerous in modern days, yet they may be referred back to the same stimuli which impelled the savage to invent the flint tipped arrow or the fire stick.

As man emerged from the savage state and became more and more civilized, to these primary needs were added others, the most important of which was the need for means of communication as distinguished from transportation, the need for means of transportation having arisen incidentally with the production of food itself. This need for means of communication was early supplied by the invention of writing, and after the lapse of centuries, it was further supplied by the invention of printing from movable type.

From the earliest civilized times then, it is clear that the most important of man's activities have been directed to the production of food and the materials for clothing and shelter; to the transportation of himself and his products from one place to another; and to means of communication.

The importance of an invention therefore, may be judged, by considering whether it has aided in production, in transportation, or in communication, for unless man can procure his prime necessities and transport them, without using up all his strength and all his time, he would have no opportunity to develop the fine arts, literature or science, and the civilization of our own time would not be possible.

Based on the foregoing considerations, the ten inventions selected as of greatest importance are as follows:

Electrical Fixation of Atmospheric Nitrogen.	Aid in Production.
Preservation of Sugar Producing Plants.	
High Speed Steel.	
Tungsten Filament.	
Aeroplane.	Aid in Transportation.
Steam Turbine.	
Internal Combustion Motor Vehicle.	
Pneumatic Tire.	
Wireless.	Aid in Communication.
Composing Machines.	

Electrical Fixation of Atmospheric Nitrogen.

For our food we are dependent primarily on the soil. A most important element in the growth of plant life, as is well known, is nitrogen, and it is an important problem, how to supply this ingredient artificially and cheaply so as to preserve soil fertility. Of comparatively recent discovery are the nitrifying organisms, which have the ability to take nitrogen from the air, but owing to the great number of varieties of these organisms, it has not been found entirely satisfactory to use them for increasing the supply of nitrogen in the soil, so that fertilizer in the form of Chili saltpeter is used to an enormous extent.

Mr. George M. Dowe, the author of the essay published on this page, is the winner of the second prize, value one hundred dollars, in the contest announced in our issue July 5th, 1913.

Mr. Dowe very systematically classes all common human activities as relating either to production, transportation or communication, and then considers in turn the principal contributions of recent invention to each of these fields.

The atmospheric fixation of nitrogen on an industrial scale shows signs even at the present day of rivaling in extent the production of nitrogen compounds from other, longer established, but less inexhaustible sources. There can be little doubt that Mr. Dowe is right in placing the development of this industry at the head of his list of inventions relating to Production.

Aids to Transportation show a particularly brilliant record of new developments during the last twenty-five years, and many will be disposed, like Mr. Dowe, to place the aeroplane at the head of this department, though only the future can show just what the aeroplane is yet destined to achieve for mankind.

And as to aids in communication—when we count the lives that have even now been saved by wireless telegraphy, who can doubt that in this field the inventions of Hertz, Marconi and the other pioneers of electromagnetic wave signalling stand first?—EDITOR.

The question that naturally arises, is the quantity of this material available.

Based on careful calculations, Mr. Edstrom, in a paper read before the American Electro-Chemical Society, estimates that the mines in Chili will be exhausted about the year 1940.

The discovery, therefore, of a process commercially practical, by which the exhaustless nitrogen of the atmosphere may be imprisoned and used to support plant life, is to be welcomed as a great achievement.

It has long been known that the electric spark, passed in air, produced a combination of the oxygen and nitrogen, giving an oxide of nitrogen. The problem was to do this on a commercial scale.

Through the efforts of Bradley and Lovejoy, and Birkeland and Eyde, apparatus have been perfected by which the electric current is used to such advantage that pure nitric acid can now be produced in sufficient quantities to make the process a commercial success.

From the acid, fertilizers in the form of nitrates are made by well known means.

Preservation of Sugar Producing Plants.

The value of sugar as a food is so well recognized nowadays that no argument to this end is needed.

In the making of sugar, however, it has been necessary, under processes until recently known, to get the sugar plant to the presses while fresh, and consequently the entire product must be handled during the harvest season. This makes it necessary to have the refining plant of sufficient capacity to handle the product in a short time.

Mr. George W. McMullen of Chicago has discovered a process of preserving the cane or beets for a long time without losing any of the valuable sugar content.

In the case of beets, for example, they are reduced to a desiccated and finely comminuted condition before the sugar is extracted. The raw material thus treated can be shipped to refineries having the most approved apparatus, and the refining can be done at leisure.

The carrying into effect of this process means a great increase in the supply of food in the form of sugar, and therefore places the invention among those of the greatest importance to mankind.

High Speed Steel.

The discovery of the method of tempering so-called tungsten steel by which tools made of it would cut at or near red heat, and not lose their temper, can be called nothing short of marvelous.

To make a tool for cutting, with a keen edge that would hold, has been so important to man, that in all stages of his history, from the age of flint to the present day, he is found endeavoring to improve its cutting qualities.

Tempering was very early discovered, certainly before the Christian era, but the practice from the earliest times has remained substantially the same, until Messrs. Taylor and White discovered their process.

According to all tradition, a steel must not be heated beyond a red heat when being tempered. What could be more astonishing therefore, than to discover that by heating tungsten steel to almost a melting temperature and then cooling, a hardness was produced that was heretofore unknown and that tools so made were able to cut at such a speed that they became almost red hot without losing either their temper or their cutting edge?

But these are the properties of this new kind of steel and its production has doubled at least the cutting capacity of tools made of it. When one can improve a tool or a machine so that its efficiency is increased five per cent it is considered noteworthy, but when the gain is one hundred per cent, the achievement is nothing short of revolutionary.

Tungsten Filament Lamp.

The production of fire by artificial means has been justly regarded as the greatest invention in the history of the human race. From the illumination of a fire to the Mazda lamp of to-day is a great triumph, but the step from any one to another and better of the various illuminants which have marked man's progress, was no greater than has almost yesterday been made in the step from the carbon filament to the tungsten filament lamp.

The very great importance of the new lamp can be appreciated when it is remembered that the tungsten lamp gives the same illumination for a little more than one third of the energy required for the carbon lamp.

To Messrs. Just and Hanaman of Austria is due the credit for the discovery of the process by which a tungsten filament could be produced which was coherent and homogeneous. It remained for Dr. Coolidge however to unfold a process by which tungsten could be successfully drawn into a wire and by which the perfected lamp of to-day is made possible.

Aeroplane.

It has been suggested in the early part of this paper, that transportation was incidental to production. In fact, it has sometimes preceded it, for before the man of the woods could catch his game he had to transport himself to the place where the game could be found.

The means of transportation used has varied with the surroundings. In the frozen lands, the sledge and snow shoes are the aids. In the briered wood, leggings as well as shoes were worn. Each of these devices gave increased speed and saved time.

It is in the race with time that man has made remarkable progress. Fast boats and fast trains now take him from place to place and the time devoted to the procuring of the prime necessities, is being ever reduced. To these achievements by land and sea, has now been added another, the conquest of the air, thus widening still further the field of available modes of transportation.

To Langley and to the Wright brothers must be awarded the chief honors in the attainment of mechanical flight. Langley furnished an immense amount of data upon which the Wrights worked, while they found out what was necessary for stable flight.

Steam Turbine.

The steam turbine marks a new era in the utilization of steam as a prime mover. Its introduction has brought about a revolution in the design of high speed machinery. It contributes to production and also to transportation; to production through its application to the generation of electricity; to transportation through its application to the swiftest steamers.

Mr. Parsons, to whom the greatest credit belongs for the introduction of the turbine, has performed a service which surpasses in importance all improvements in the utilization of steam since the days of Watt.

Internal Combustion Motor Vehicle.

The wonderful *elasticity* which the internal combustion motor vehicle has given to transportation gives it a place among the greatest modern inventions. But this is not its only field of importance. It has been applied in production also, and it is in this field that its use is beginning to be more and more appreciated. Not only in the large tractor by which several furrows are plowed, harrowed and seeded at one operation, but in the small implement for farm use is the wonderful adaptability of this form of vehicle shown.

While numerous inventors have contributed to the development of various parts entering into the perfected vehicle of to-day, the names most prominently connected

(Concluded on page 372.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

CONVERTIBLE FUR PIECE.—G. EPSTEIN, 337 E. 8th St., Manhattan, N. Y., N. Y. This outer wrap is in the nature of a fur piece, which may be readily changed from one form or purpose to another so that the owner of the garment at one time or for certain occasions may use the piece, for instance, as a scarf, and again, as when wearing a fur coat, she may convert the scarf into a muff of either the rug or pillow design.

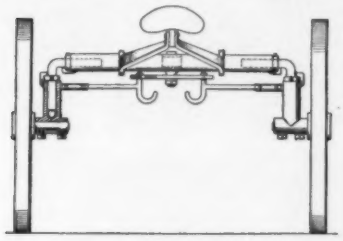
Electrical Devices.

SIGNALING DEVICE FOR ESTIMATING DISTANCES.—J. U. SMITH, 2320 Ward St., Berkeley, Cal. This invention comprehends the use at the transmitting station of an oscillator for Hertzian waves, or their equivalent, which travel directly through the ether at the speed of light, and a bell or other device located under water for propagating acoustic disturbances, the receiving station comprehending a wave detector responsive to the oscillator, and also including a sound-controlled telephonic transmitter, this and the wave detector being arranged to control currents passing through a telephone receiver.

Of Interest to Farmers.

CULTIVATOR.—J. B. DENHAM and G. VANCE, Sandford, Ind. The present invention contemplates overcoming the necessity of cultivating with two operations, an object being to provide means whereby cultivation and destruction of undesirable growth may be performed between the rows of plants, both longitudinally and transversely, simultaneously.

CULTIVATOR.—V. LAUER, Stillwater, Okla. The intention here is to provide a wheeled device wherein the wheels are so connected to the cultivator that the driver may simultaneously swing the wheels with respect to the cultivator to change the direction of movement of the cultivator, and may hold the said wheels at any desired angle with respect to the cultivator.



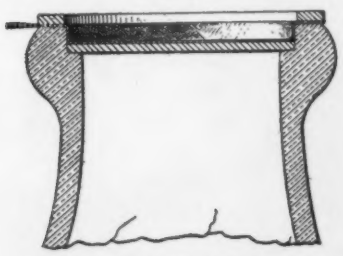
CULTIVATOR.

Of General Interest.

BLUE-PRINT FRAME.—J. A. HIRSHBERG, 215 E. 26th St., Manhattan, N. Y., N. Y., and J. W. HARTLIEB, N. Y., N. Y. The primary object of this invention is to so mount a plurality of binding strips upon the main frame and to operatively connect them as to make them all operable simultaneously by a single movement of an actuating member.

CONCRETE CONSTRUCTION.—G. F. MILLS, Cottagehill, Fla. In the present patent the invention has reference to concrete construction, and it has for its object the provision of molds for concrete window frames, and means by which the sash pulleys and weights may be disposed in the concrete frame.

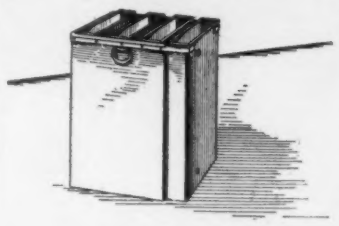
BOTTLE CLOSURE.—R. E. REDDING, 1325 So. 9th St., Terre Haute, Ind. The invention provides a closure which is more sanitary than the ordinary pasteboard disk. This is due to the provision of a cloth strip which forms an auxiliary closure member and prevents dirt and dust from entering the bottle while the main closure member is being removed. It also provides a device having a closure of the type described which may be readily taken off or applied to the bottle.



BOTTLE CLOSURE.

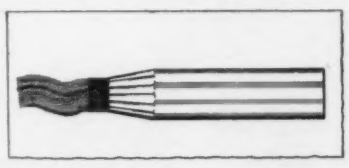
KILN.—W. DRAYTON, Greendale, Ohio. Several of the principal objects of this invention are: to provide a kiln having a tunnel like structure to convey material being handled through the kiln by stations; to provide a plurality of platforms to carry material being handled; to provide a system of seals to prevent admission of heat to the metal frame and rotating parts of the platforms named; to provide a plurality of platforms arranged in conjunction with the above mentioned platforms to confine the heat within certain areas; to provide for preventing pocketing of air; to provide for mixing burned atmospheric air; and to provide means for resisting heat of a degree higher than that required for the burning of material being handled.

DEVELOPING TANK.—J. H. DROSSER, Douglas, Ariz. The aim of this inventor is to provide a main tank for holding water, and so arranged that a continuous flow of cooling liquid may be passed through the main tank during the operation, together with a plurality of auxiliary tanks for containing the various fluids, supported in the main tank, and means in connection with the main tank for holding one of the auxiliary tanks of the main tank.



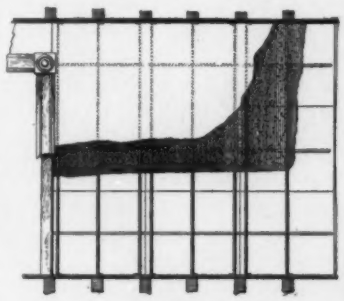
DEVELOPING TANK.

PENCIL.—J. A. WALLS, 39 U. S. Fidelity Bldg., Baltimore, Md. The invention is of use more particularly for pencils for writing ornamental signs and the like. The essential object is the provision of a pencil core so formed that in writing a succession of signs a ribbon-like appearance will be given, which will show a progressive development of striated form, whereby an erasure or interpolation may be readily detected.



ORNAMENTAL SIGN WRITING PENCIL.

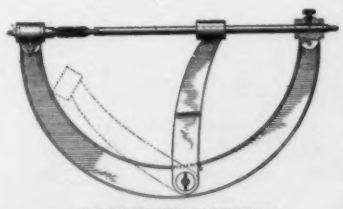
FIREPROOF PARTITION.—G. H. GERAERDTS, 1346 Boone Ave., Bronx, New York, N. Y. In order to accomplish the purpose of this invention use is made of fireproof boards, of plaster or the like, set up on edge and abutting at their edges, vertical bars attached to the floor and ceiling of the building and in contact with the opposite faces of the set-up boards, and longitudinal rods held on the said bars adjacent the faces of the said set-up boards.



FIREPROOF PARTITION.

Hardware and Tools.

MICROMETER CALIPERS.—J. H. MÜLLER, 1512 E. 24th Ave., Oakland, Cal. To obviate several difficulties Mr. Müller has invented a caliper which refers more particularly to the class comprising a U-frame, having a removable micrometer screw at one end and a graduated, adjustable and reversible measuring point at the opposite end and clamping means associated with the heads of the U-frame, so that his caliper, having only one micrometer measuring point and one graduated measuring point, any measurement from zero to the size of the U-frame may be made.



MICROMETER CALIPERS.

NUT LOCK.—W. B. MAXWELL and G. C. MAXWELL, care of John Silvestro, 1 W. 34th St., New York, N. Y. This invention facilitates the application of the nut with the least amount of trouble, and provides for its ready removal when desired, the construction, however, being such that the nut is positively locked preventing accidental or unintentional loosening thereof.

Machines and Mechanical Devices.

CANISTER SUPPORT.—A. H. CUREAU, 42 Hamilton Place, Tarrytown, N. Y. This invention relates to a convenient mechanism for supporting a canister designed to hold tea, flour or any commodity; and it also includes means for mounting the support upon various fixtures and for supporting shelves or the like by the aid of the canister support.

VALVE GEAR.—C. B. PIRIE, 408 E. 6th St., McCook, Neb. The invention provides means for readily changing the lead of valve gears of the Walschaert type. The combination lever is provided with a slot, in which slides a block connected with the valve stem, so that this lever may be raised by a link connected with an operating device in the engine cab for changing the lead of the engine.

DATING MACHINE.—E. E. GREGORY, Central City, Kan. Mr. Gregory's invention relates to dating machines, particularly for use in banks, real estate and loan offices, and more particularly to an apparatus embodying stamping wheels for the years, months, and days of the months, having means for advancing a predetermined number of days through a single actuation of a certain portion of the machine for this purpose.

DATING MACHINE FOR BANKS, OFFICES, ETC.

ANIMAL TRAP.—S. P. VERNER, Cristoval, Canal Zone. This trap is more especially designed for caging animals alive and uninjured, and arranged to permit ready concealment, to provide access to the trap from every direction except the bottom, to prevent the escape of the animal caught, and to protect the caught animal from attack by other animals.

PROJECTING APPARATUS.—H. KRIEGER, 168 Brown Place, Bronx Borough, N. Y., N. Y., and C. F. DEWEY, same borough. The invention provides an apparatus for use as a dissolving view apparatus for projecting pictures, advertisements and the like singly or for use in connection with a moving picture machine to permit the user to display the pictures on the screen while the film in the moving picture machine is changed.

Pertaining to Recreation.

TABLE ARCHERY.—J. MORRISON, Jr., 2½ Gage St., Glens Falls, N. Y. This invention relates to games; particularly archery, the game being characterized by a target board of peculiar construction adapted to be used with a number of darts or arrows, the coaction of the parts being such that the target will retain the darts and arrows when brought into engagement therewith.

COASTING DEVICE.—D. GINGOLD, 503 Water St., New York, N. Y. This invention refers to pleasure devices and particularly to devices used especially by children in coasting on pavements by the use of wheels, or upon snow and ice by means of runners. The device is improved with respect to the steering mechanism and adjustability according to the stature of the user.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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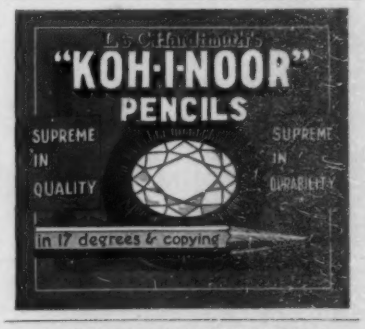
FOR SALE: New Patented Molding Machine. Would also be prepared to enter into partnership in a foundry which manufactures for extensive trade. K. Fritz, 330 North St., Bethlehem, Pa.



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How does light, heat and oil affect tires?
They would have an injurious effect, as they are the natural enemies of rubber. Tires not in use can be protected from light by being wrapped in black paper and stored in a cool place. Any oil on a tire should be cleaned off immediately with benzine or gasoline. Oil rots rubber and destroys its elasticity.

If tires are practically new or in good repair, and rims in good shape, it will be sufficient to leave them on the car, taking pains to remove all oil and grease from the tires. Wash them with good strong soap and water. If the rubber is cut to the fabric, be sure to have the injury repaired before using the car again.

Is such a thing possible as keeping tires free from constant contact with oil?
This question is raised by these typical paragraphs clipped from booklets of various tire manufacturers. Diligence may do it—but it spells DIFFICULTY too—in capital letters.
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Do oiled roads affect treads?
Oil if allowed to remain on treads will soften and weaken them. Oil causes the deterioration of rubber and destroys its life.

Never allow tires to stand in oil at the garage or elsewhere, and be particular to wipe off any oil that may drop on the tires at any time. Lubricating oil greatly softens the rubber, makes it pasty and gluey-like in consistency and takes all the resistance and elasticity out of it. This oil may be cleaned from the tires with gasoline, as gasoline evaporates and does not result in injury.

Bear in mind that neat, light mineral oils are natural enemies of rubber. When grease comes in contact with your tires, it should be removed immediately with gasoline or benzine.

More than a year has now elapsed with amazing results in increased mileage. The reality of the oilproof quality and its definite value as an extra service factor is best expressed by our recent increase of the guarantee on Vacuum Cup Tires to
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An Independent Company with an independent selling policy

The Jungfrau Railway

(*Concluded from page 360.*)

cier in other quarters makes the Jungfrau Pass unique among Alpine viewpoints.

The railway also materially shortens the journey, on foot, to many points of interest. The summit of the "Monk" or that of the Jungfrau can be reached in five hours from the Jungfrau Pass station and with the aid of the railway the journey from Interlaken to Zermatt can be accomplished in a day by a very easy route. From the Jungfrau Pass a walk of a few hours over the Aletsch glacier brings the tourist to the beautiful Lake Märjelen, whence a mule path leads down to Fiesch, in the Rhone valley.

It had been estimated that the railway would pay if it carried 50,000 passengers annually. It actually carried 84,000 in the year 1911, and in one day, immediately after the opening of the Jungfrau Pass station last summer, it carried more than 2,400, of whom more than 1,300 visited the pass. These figures prove the correctness of Guyer-Zeller's assumption that there are a great many persons who long to enjoy the beauty and grandeur of the lofty mountain peaks and glaciers that they could never hope to reach by their own exertions. Hence the building of the Jungfrau railway should be esteemed as a work of civilization that opens to all the wonders of nature which could hitherto be enjoyed only by a few.

Before long the drills and the dynamite cartridges will again be at work, and the tunnel will be pushed forward to a point directly beneath the summit of the Jungfrau, to which the visitor will be lifted through an elevator shaft, 260 feet deep.

The Daniel Boone Idea in Education

(*Concluded from page 361.*)

—and work. The construction of buildings enough to house 150 boys and teachers in three months was obviously a task even beyond the resources of the militant Interlaken boys. Regular workmen and contractors, therefore, built several of the dormitories. But the biggest and most picturesque the boys designed and constructed themselves. The Interlaken buildings, the visible evidences of the school, by their very history and type of construction thus symbolized the overmastering purposes of the institution—the gospel of mind and character training through work.

The new boy at this school, as at all others, is more than likely to be a specimen representative of the city. Soft in his muscles, a little softer perhaps in his mental processes, absolutely removed thousands of miles from any real human experience, the Interlaken School at first impresses him rather as a punishment than an opportunity. To his horror he learns that not only is he expected to cast aside his fine raiment for rough and ready clothing, but that there are really only three or four servants at the school, and that the boys do nearly all the work. The instinct of the average adolescent citizen, under these circumstances, is outright rebellion. He secretly resolves that he will not have anything to do with any such degrading routine. Such a resolution is easy. Though work is the school's ruling idea, such work is purely voluntary. Any boy can enter, confine all his time to the academic studies, and leave manual labor entirely alone. No one forces him to do anything; if he is that kind of a boy, he can sit day after day and be waited upon by his fellows—most of them, as he presently discovers, as "good," which means as rich as himself. He can eat the food that others have raised; enjoy the steam heat and electric lighting that other boys are preparing for him; pick the flowers that others have planted; and stroll up and down the walks, and spend his evenings in the log cabins that other boys like himself have put up.

For a few days the new boy may hold himself aloof. Then a certain sense of discomfort settles down upon him. In his other school experiences he has always found himself looked up to—has always been something of a leader. But here things are not going so well. The boys treat him pleasantly enough; but they do not regard him as a hero. Now, every real boy cares more for the approval of his own boy world than the approval of his parents or relations or teachers. If the boys make heroes of athletes, he will try to become athletic; if scholarly attainments are prized, he will immediately manifest a great interest in his books. At Interlaken the hero is the boy who has charge of the steam plant, the boy who distinguishes himself above all others at construction work, the boy who is the best farmer. The newcomer quickly perceives that the way to distinction lies in developing callous hands. His attitude slowly changes. His white color disappears; outing shoes and leggings supplant his once immaculate footgear.

Thus transformed the new boy has little difficulty in accommodating himself to the changed *régime*. In the morning he rises promptly at six o'clock. There are no bells, no whistles, no Chinese gongs, just as there are no rules, no terrifying list of "don'ts." There are only four servants—two Japanese cooks and two helpers—to supply the gastronomic needs of nearly two hundred people. The boys do all the rest of the kitchen work themselves; they lay the tables, serve the food, clear away and wash the dishes. After breakfast they spend half an hour setting their rooms in order. The school employs no chambermaids and no sweeps; the boys make their own beds, sweep out the room and have everything in good order for inspection at eight o'clock.

The time from eight until twelve-thirty is devoted entirely to the classrooms. Here the usual school exercises hold sway. But the teachers impart instruction in an unconventional fashion; they try to relate the old scholarship to the facts of modern life. Formal discipline is lacking. The boys are not assigned to definite seats. They gather in a circle about the teacher, ask and answer questions. A classroom recitation resembles somewhat the conversation of well-bred people. In the science classes, the boys in the main, manufacture their own apparatus.

After one o'clock the situation entirely changes. Leaving the dining-hall, the boys gravitate toward a large bulletin board. A hundred eager eyes scan the inscriptions; for here the masters have written down the "assignments" for the afternoon. On the board are written the names of half a dozen boys, who are expected to spend the afternoon plowing with two sixty horse-power tractors. Another contingent learns that it is to devote itself to corn, another to sowing cow peas; still another to laying out gardens for raising vegetables. If it is winter time perhaps the ice is to be harvested; if it is summer the hay is to be cut and made, and the corn crop is to be garnered. A large contingent finds its way into the shops, where tables, chairs, desks, and bookshelves are to be made, all for the use of the school. A year or two ago the boys made two silos, large enough to hold sixty acres of corn. The immutable rule is that of manual labor; and on a farm of eight hundred acres there is plenty of work to keep all the boys usefully employed.

Every afternoon—from four to six—the boys have plenty of time for play. In spring they crowd the baseball diamonds and tennis courts—their enjoyment not decreased by the fact that they have leveled and staked out these playgrounds by their own labor. In fall there is soccer; in winter skating and hockey and playing. Every night there are gatherings around the fireplaces in their own and the masters' rooms—for study, reading, and conversation. There may be lectures and private theatricals. Occasionally some of the boys decorate one of the halls, invite their girl friends out from La Porte and have a dance. At other times they don their evening clothes and accept invitations to a cotillion in town. For, according to the philosophy that reigns, evening clothes are as essential to a full rounded

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American citizen as corduroy trousers and a sweater. The school's primary purpose is not to make farmers or carpenters or orchardists, but to make men. Its theory in giving the boys this manual labor is the fundamental idea elaborated at the beginning of this article, that the human mind progresses most satisfactorily along with muscular and hand training. The product at which the school ultimately aims, therefore, is the sympathetic, understanding, resourceful, clean living, clean thinking American gentleman.

The Completion of the Los Angeles Aqueduct

(*Concluded from page 365.*)

Classification.	Length in miles.
Open unlined canal	23.802
Open lined canal	37.168
Covered conduit	97.641
Tunnels	42.903
Power tunnels	8.906—51.809
Siphons, steel and concrete	12.052
Flumes	0.165
Reservoirs	7.870
Haiwee reservoir tunnel outlet	0.226
Haiwee bypass	2.000
Power siphons	0.239
Power penstocks and tailrace	0.700
Total length of aqueduct (to San Fernando)	233.672

operation from that of the aqueduct.

In 1906 E. F. Scattergood, the aqueduct's chief electrical engineer, made an estimate of the cost of development of 37,000 horse-power, delivered at the city boundary, at $4,490,000. April 10th, 1910, Los Angeles voted bonds to the extent of $3,500,000 for the purpose of partially developing the electrical power of the aqueduct, which eminent electrical engineers estimate at 120,000 horse-power peak load. It is not the intention to develop the full amount at this time; but eventually, as the demand for power increases, as it inevitably must, plants sufficiently extensive to develop all the power possible will undoubtedly be put in. Mr. Mulholland on one occasion made this public utterance on the subject: "I believe that the people have in the possible power development from the aqueduct an investment which twenty years hence will turn back into the city treasury the entire $24,500,000 provided for the construction of the aqueduct, with interest." This opinion is sustained by the hydraulic and electrical engineers who have been called upon to examine the work.

The first electric power plant is 47 miles from Los Angeles, at Clear Water Canyon. The water is led from the mouth of Elizabeth tunnel 935 feet down the precipitous side of the canyon upon the power producing waterwheels, whence the current will be transmitted to the city over high-tension lines. The plant being erected will produce 37,500 horse-power, and it can be increased at this point by additional construction to a limit of 75,000 horse-power. After leaving the wheels of the first power plant, the water will be carried seven miles along the rim of San Francisquito Canyon and dropped down 512 feet upon the wheels of a second power plant to be built whenever the demand for additional electrical energy shall require it. A third power plant to develop a maximum of 10,000 horse-power can be built between the aqueduct outlet and the upper San Fernando reservoir. And still another power plant, capable of producing 3,400 horse-power, can be placed on the main trunk line to the city at Franklin Canyon, in the Santa Monica Mountains.

There is considerable work yet to be done in the way of finishing up the odds and ends of the great aqueduct work, such as building distributing systems for the surplus water for irrigation purposes, and for transmission and distributing systems for electrical energy. There is a vigorous demand for both water and power, however, and the satisfactory completion of these distributing systems, large in themselves but insignificant in comparison with the work of building the great Los Angeles aqueduct, will be a matter of but a short time.

A two days celebration of the completion

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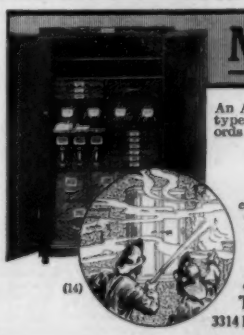

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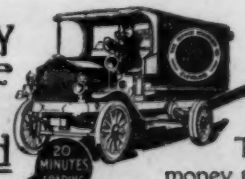

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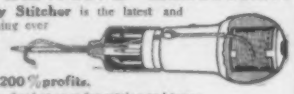

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What Are the Ten Greatest Inventions of Our Time?

(Concluded from page 368.)

with its early progress are probably those of Daimler, Ford and Duryea.

Pneumatic Tire.

If fifty years ago I were asked to name the greatest invention of the time, the answer would probably have been the locomotive. When a hard smooth tramway was first conceived, the beginning of the future greatness of the locomotive had been made.

What the track has done for the locomotive, the pneumatic tire has done for the vehicle not confined to tracks. Here the advantages of the track must be produced in the tire. Shock must be reduced to a minimum and sufficient traction must be provided. Both these factors the pneumatic tire possesses to a high degree. By its use, the automobile of to-day is possible, with its high speed and smooth riding qualities, and by its use also the amount of power to pull a given load is much reduced, thereby aiding man in the transportation of himself and his goods.

To the efforts primarily of Bartlett, the inventor of the clincher tire, and of Dunlop, the inventor of the wired-on tire, are due the practical results in tire construction.

Wireless.

The development of the means of communication from one place to another by signals of some kind makes a remarkable chapter in the history of invention. When early man went with a few of his companions to a distant place for any purpose, it was often of great importance for those left behind to know how their companions fared.

This need for some means of communication has always been felt, and it has been supplied in different stages of progress by the fire kindled on lofty hilltops, by the semaphore, by the electric telegraph, by the telephone, and finally by means of the Hertzian waves. Each and all of these methods of communication have been devised to meet the needs of commerce primarily, but incidentally they have contributed to social intercourse.

While the development of wireless has been of gradual growth, and a number of inventors have been at work on its problems, to Marconi must be given the credit of making it commercially practical.

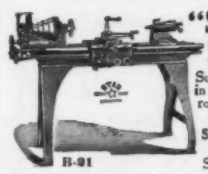
Composing Machines.

While the production of fire artificially is probably the greatest achievement of the human race, yet the discovery of the art of printing certainly stands high among the great inventions of civilized man.

From the time of Gutenberg, however, until recent times, no substantial change in the manner of composing has been made on a scale which could be considered commercial. Printing has improved from the rude hand press to the giant rotary press of to-day, but the composing end has stood still until the introduction of two brand new types of devices, the Linotype and the Monotype.

Before the advent of these, attempts had been made to produce a typesetting machine, and while the actual setting could be done, the problem of redistributing the type was still unsolved. The suggestion that types be made with differently located cuts or notches was not practical, since that necessitated a change at the type foundry.

The new machines, however, completely solved the problem as practically presented, by making a typecasting device a part of the machine, so that composing and casting are now done at the printing office, each machine being a composing device and a type foundry.



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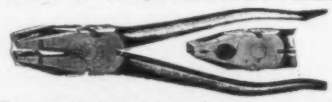

These are only a few suggestions; just stop a moment and think it over! (It's worth while) and saves time, money and worry. May we send our Plier Pointers? You do not obligate yourself in any way to ask for it.
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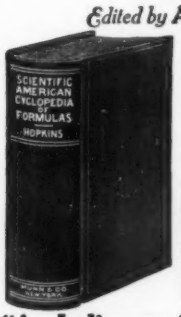

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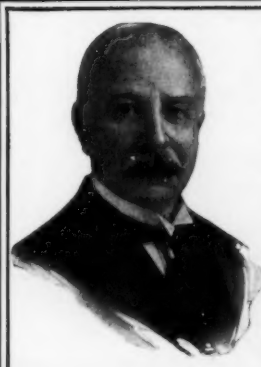

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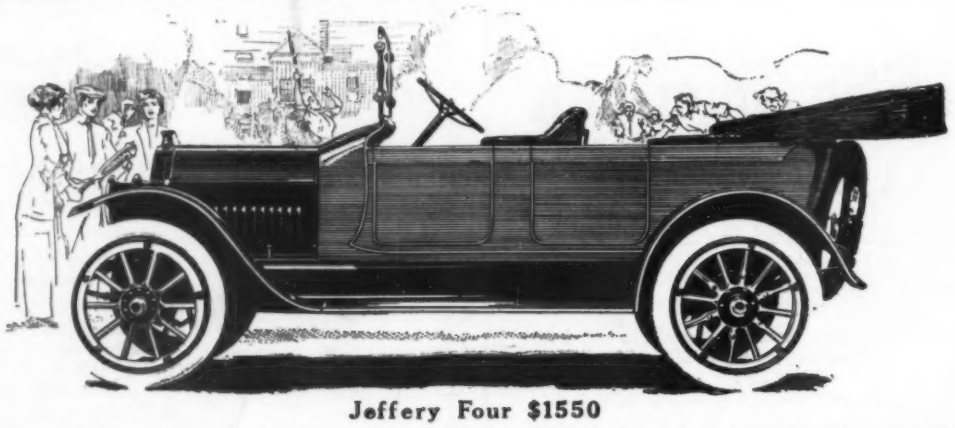
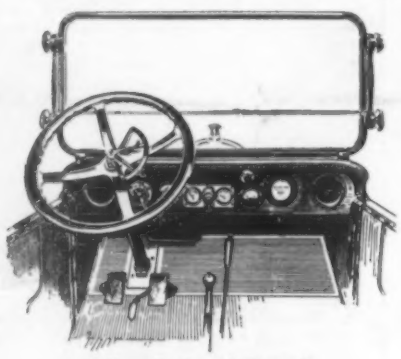


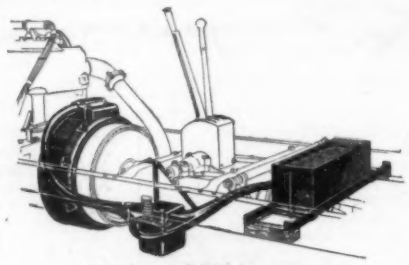
Jeffery Four $1550

Look over the specifications and you'll see why this is the greatest value ever known, and why we invite comparison with cars costing twice as much



Jeffery Dash and Controls

Motor—Jeffery high speed mono-block—40 H. P. at 2200 revolutions.
Cylinders—3¾ x 5¼ powerful; car goes 43 miles per hour on second speed.
Lighting and Starting—U. S. L. System.—best and most expensive. Quiet, quick and powerful.
Clutch—Perfected cone. Practice has proven this to be the best.
Transmission—Shafts-Vanadium Steel, hung on five imported annular bearings. Four speeds forward—one reverse.
Wheel base 116 inches—Car turns in 42 feet.
Wheels—34 x 4 large hub, demountable rims.
Drive—Left Drive—Rear Axle full floating type on imported annular bearings.
Color and Design—Brewster Green Rothschild body; there is no better. Wide doors. Luxurious upholstery.
Stewart-Warner Speedometer; Ammeter; Klaxon; extra demountable rim; top, of best material; rain vision wind shield; electric lights with dimmer.
Brakes—Two; very powerful and effective.
Styles—5 Passenger touring or 2 Passenger Roadster, $1550; 2 Passenger Coupelette, enclosed, inside drive, $1950; 4 Passenger Sedan, enclosed inside drive, $2350; 5 Passenger Limousine, $3000.



Starting and lighting system
No gears, bolts or chains

A Jeffery circle will be sent if you ask for it

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The Jeffery Six is a duplicate of the wonderful Jeffery Four, except for size. A remarkable car! If you are an advocate of the six cylinder car, don't fail to learn all about this one. It's what you want; powerful, luxurious, beautiful. Price $2250.

Dealers recognize the great advantage of being able to sell these new Jeffery cars and are clamoring for the opportunity. These cars are making a new epoch in the automobile world.

The Thomas B. Jeffery Company

46 Main Street, Kenosha, Wisconsin